

BUREAU OF ECONOMIC GEOLOGY
The University of Texas
Austin, Texas

Peter T. Flawn, Director

Report of Investigations — No. 59

Lower Cretaceous Sands of Texas: Stratigraphy and Resources

By
W. L. Fisher and Peter U. Rodda



March 1967

QAe2962

BUREAU OF ECONOMIC GEOLOGY
The University of Texas
Austin, Texas

Peter T. Flawn, Director

Report of Investigations—No. 59

Lower Cretaceous Sands of Texas: Stratigraphy and Resources

By

W. L. Fisher and Peter U. Rodda



March 1967

CONTENTS

	<u>Page</u>
ABSTRACT	1
INTRODUCTION	1
ACKNOWLEDGMENTS	1
STRATIGRAPHY	2
Areal distribution	2
Stratigraphic sequences	3
North-central Texas	3
West-central Texas	5
North Texas	10
Central Texas	10
PHYSICAL, MINERAL, AND CHEMICAL PROPERTIES	15
Grain size and distribution	15
Mineral composition	15
Chemical composition	16
RESOURCES	17
Definition and utilization	17
Specifications	17
Quality and beneficiation	19
Mining and processing	19
Production, consumption, and value	20
Summary of principal deposits and economic considerations	22
BIBLIOGRAPHY	26
APPENDICES	28
A. Methodology	28
Field sampling and description	28
Laboratory preparation and analyses	28
B. Results of tests	30
INDEX	113

ILLUSTRATIONS

<u>Figures—</u>	<u>Page</u>
1. Index map of study area	2
2. Generalized isopach maps of principal Lower Cretaceous rock units	4
3. Pinch-out and inferred original extent of Glen Rose Formation in western part of North-central Texas	6
4. Stratigraphic relationship of Antlers Formation of West-central Texas and Lower Cretaceous sequence of North-central Texas	8
5. Stratigraphic relationship of Antlers Formation of North Texas and Lower Cretaceous sequence of North-central Texas	9
6. Lower Cretaceous sands (Antlers Formation) exposed in bluff along Red River, Cooke County, Texas	11

<u>Figures—</u>	<u>Page</u>
7. Particle-size distribution and rock composition of representative basal Cretaceous conglomerates and conglomeratic sands	12
8. Stratigraphic relationship of Lower Cretaceous sequences of North-central and Central Texas	13
9. Photomicrographs of representative Lower Cretaceous sands	14
10. Distribution of Lower Cretaceous sands based on mean grain size and sorting, compared to commonly specified size ranges for selected industrial uses	18
11. Location of area of investigation in relation to principal industrial sand producers and consumers	21
12. Location and distribution of principal Lower Cretaceous sand deposits in relation to existing North-central Texas market area	24

Plates (in pocket)—

- I. Geologic map of Lower Cretaceous sands and associated formations, Texas.
- II. Stratigraphic and nomenclatural units, basal Cretaceous rocks, Texas.
- III. Areal characteristics (mean grain size and sorting) of principal Lower Cretaceous sands, Texas.

TABLES

<u>Tables —</u>	<u>Page</u>
1. Nomenclature and correlation of Lower Cretaceous rock units	3
2. General specifications and requirements of industrial sands	17
3. Production and value of different grade sands in Texas	20
4. Average value of industrial sands produced in United States	22
5. Tabulation and evaluation of principal industrial sand deposits (Lower Cretaceous) of North-central, North, and West-central Texas	23

ABSTRACT

Lower Cretaceous sands, important as fresh-water aquifers and as sources of industrial or silica sands, are extensive in North-central, North, and West-central Texas. These sands occur in separate sequences recognized by changes in facies of sand units and presence or absence of associated limestone units and include: (1) North-central Texas outcrop sequence consisting of (in ascending order) Twin Mountains Formation (sand and clay), Glen Rose Formation (limestone and clay), and Paluxy Formation (sand and clay); (2) North-central Texas subsurface basinal sequence consisting of Hosston Formation (sand), Sligo Formation (limestone), Pearsall Formation (clay and limestone), Hensel Formation (sand), and Glen Rose Formation (limestone and clay); (3) Central Texas outcrop sequence of Travis Peak Formation, locally differentiated as Sycamore Sand, Hammett Shale, Cow Creek Limestone, and Hensel Sand, overlain by the Glen Rose Formation; and (4) North and West-central Texas outcrop sequences made up of sand and clay equivalents of the Twin Mountains, Glen Rose, and Paluxy Formations, considered as a single unit—Antlers Formation.

A few deposits of Lower Cretaceous sands will meet purity and grain size specifications for certain industrial uses with a minimum of beneficiation (washing and sizing); about one-third of the deposits investigated could be brought to acceptable grades but would require more extensive beneficiation. Several deposits in North-central Texas are favorably situated with respect to a significant market area currently supplied chiefly by industrial sands obtained from other than Lower Cretaceous deposits as well as out-of-State sources. Utilization of industrial sand deposits in West-central Texas probably depends on development of a local market in that area.

INTRODUCTION

Lower Cretaceous sands have long been important aquifers in Central, North-central, and North Texas. In recent years these sands also have been sources of high-silica industrial or specialty-purpose sand. Lower Cretaceous sands of northern Texas and Cenozoic sands of the Texas Coastal Plain comprise the main resources of high-silica sands in the State. Knowledge of their occurrence, distribution, stratigraphic relation, quality, and

suitability for industrial uses is necessary to their future development. Annual production of silica sands in Texas amounts to about 500,000 tons valued at \$2.4 million. Annual consumption currently is about 700,000 tons and in recent years has increased steadily within the State, especially for such uses as glass manufacture, foundry moldings, and mineral fillers. A large part of the total State consumption of industrial or silica sand is by industries in North-central Texas, just east of the main belt of outcropping Lower Cretaceous sands.

Other industrial sand resources recently investigated within Texas include Central Texas Cambrian sands (Barnes and Schofield, 1964); East Texas Cenozoic sands (Fisher, 1965); Texas coastal sands (Garner, MS.), and South Texas Cenozoic sands (Maxwell, 1962). These and the deposits discussed in the present report include most of the current and potential industrial sand resources of the State.

The area studied in this report is the outcrop of Lower Cretaceous sands in Central, North-central, North, and West-central Texas (fig. 1). Approximately 175 samples were collected and analyzed from 114 localities in the following counties:

Bosque	Denton	Parker
Callahan	Erath	Somervell
Coleman	Hamilton	Tarrant
Comanche	Hood	Taylor
Cooke	Montague	Wise
Coryell	Nolan	

ACKNOWLEDGMENTS

We acknowledge critical reading of the manuscript by Peter T. Flawn, Director, Bureau of Economic Geology, Gus K. Eifler, Jr., Bureau of Economic Geology, and Henry McCabe, Heart of Texas Mining Corporation, Dallas. W. R. Payne assisted in field work and collection of samples; L. E. Garner made X-ray determinations; D. A. Schofield made grain-size determinations and chemical analyses; T. H. Brown processed statistical data and prepared histograms. Courtesies extended by R. B. Mayfield, Capitol Silica Products Company, Cleburne, and by personnel of the former Santa Anna Silica Sand Company, Santa Anna, are also acknowledged. Josephine Casey edited the manuscript, prepared the index, and saw the publication through the press. Illustrations were prepared under direction of J. W. Macon.

area of low relief with thick vegetation (sand roughs) generally similar to that of the Western (or Upper) Cross Timbers of North Texas.

Stratigraphic Sequences

Areally delineated stratigraphic sequences containing Lower Cretaceous sands are recognized in the northern part of the State on the basis of (1) changes in facies of sand units or (2) presence or absence of associated limestone units (table 1). These include (1) North-central Texas where sands in the Paluxy Formation occur above Glen Rose limestones and sands in the Twin Mountains Formation occur below Glen Rose limestones; (2) North Texas where sand and clay correlative with the Paluxy, Glen Rose, and Twin Mountains Formations are grouped singly as the Antlers Formation; (3) West-central Texas where Lower Cretaceous sands likewise are included in the Antlers Formation, a single cartographic unit; and (4) Central Texas (north and east sides of Llano Uplift) where Lower Cretaceous sands occur locally in the Paluxy Formation, but where sands below the Glen Rose Formation (Travis Peak Formation) comprise a facies distinct from basal sands of North-central Texas. Nomenclature of stratigraphic units used in this report is that of Fisher and Rodda (1966).

North-central Texas. — The North-central Texas Lower Cretaceous sequence considered in this report includes (in ascending order) sands and clays of the Twin Mountains Formation (Fisher and Rodda, 1966), limestones, marls, and clays

of the Glen Rose Formation, and sands and clays of the Paluxy Formation. The Twin Mountains Formation crops out in a continuous belt in the western part of the area from northern Brown County to southern Wise County (Pls. I and II). The formation is also exposed as an inlier along drainage of the Paluxy River in northwestern Erath and western Hood counties. In northwestern sections, (e. g., Twin Mountains, Erath County) the Twin Mountains Formation consists of a lower part composed of two or three sand units separated by relatively thin clay intervals, with an aggregate thickness of about 100 feet. The upper part, beneath limestones of the Glen Rose Formation, includes approximately 60 feet of red, gray, and green silty clays. To the south and east the Twin Mountains Formation thickens (fig. 2), the upper red, gray, and green clays apparently grade laterally to limestones and clays of the lower part of the Glen Rose Formation, and the formation consists of two sand units separated by a thin clay interval (e. g., sections near Dublin in Erath County, Weatherford in Parker County, and east-central Erath County, Pl. II). Southeastward (down dip) in the subsurface the Twin Mountains Formation grades to a basinal sequence which is differentiated into (in ascending order) Hosston Formation (sand), Sligo Formation (limestone), Pearsall Formation (clay and limestone), and Hensel Formation (sand), overlain by limestones of the Glen Rose Formation.

Sands in the Twin Mountains Formation of North-central Texas are buff to light gray, commonly weathering light reddish brown or stained red surficially by associated red clays. They

Table 1. Nomenclature and correlation of Lower Cretaceous rock units.

North-central Texas (subsurface, eastern part)	Central Texas		North-central Texas	North Texas (north of Decatur)	West-central Texas (west of 99th M)			
	Travis County	Northeast side, Llano Uplift						
Fredericksburg formations	Fredericksburg formations	Fredericksburg formations	Fredericksburg formations	Fredericksburg formations	Fredericksburg formations			
Glen Rose Limestone	Glen Rose Limestone	Paluxy Formation	Paluxy Formation	Antlers Formation	upper unit			
		Glen Rose Formation	Glen Rose Formation		middle unit			
Hensel Formation	Hensel Sand	Travis Peak Formation	Twin Mountains Formation		Antlers Formation	Antlers Formation		
Pearsall Formation	Cow Creek Limestone			upper unit			lower unit	lower unit
	Hammett Shale			middle unit				
Sligo Limestone	Sycamore Sand			lower unit				
Hosston Formation								

~~~~~ Unconformity  
 - - - - - Tentative correlation

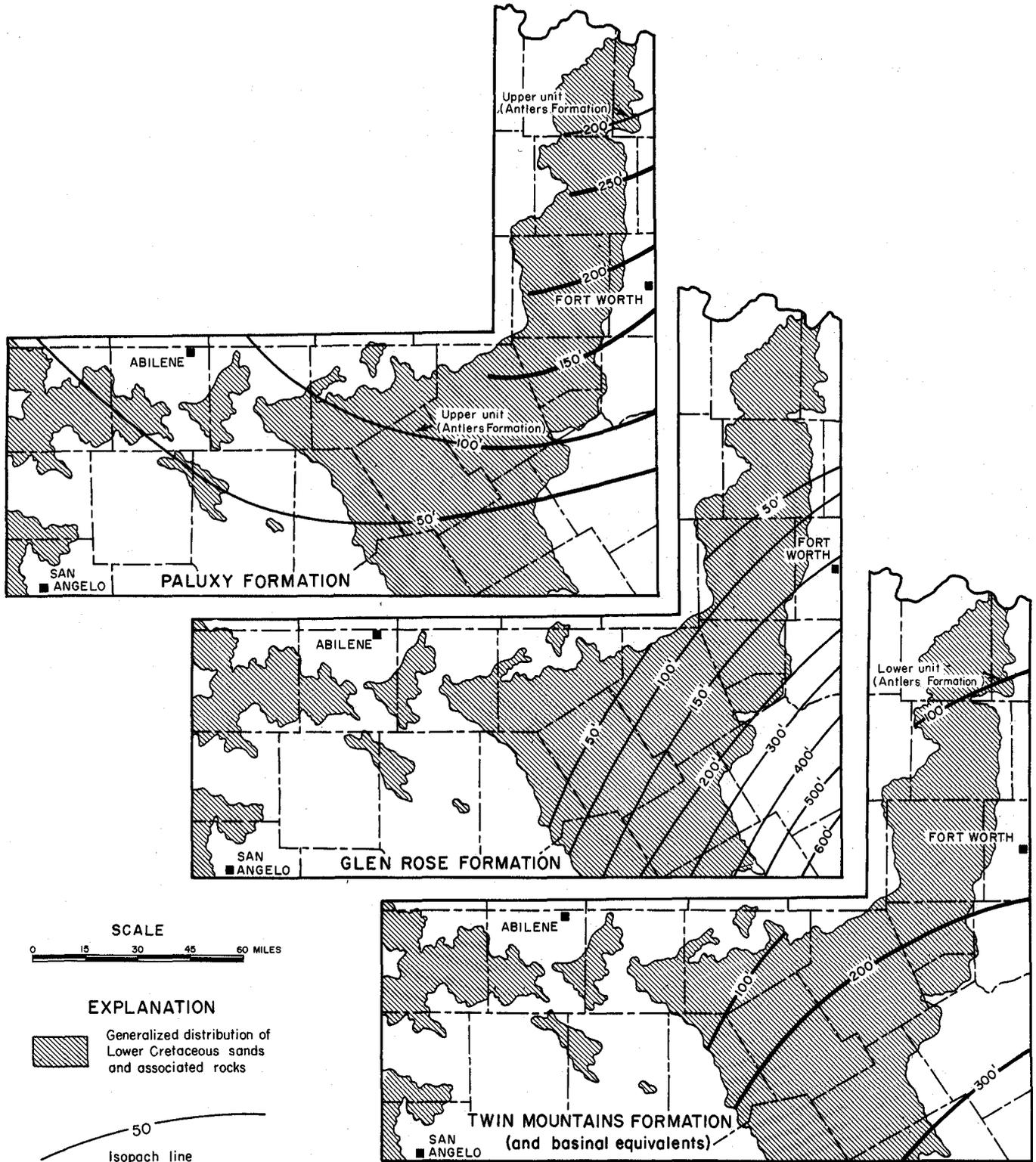


Fig. 2. Generalized isopach maps of principal Lower Cretaceous rock units.

are typically medium grained, with range from fine to coarse grained, generally coarser toward the base and finer toward the top. Small to moderate scale cross-bedding is common, especially in lowermost sands. Siliceous granules and pebbles (chiefly chert, quartzite, and quartz) occur as beds of conglomerate or in conglomeratic sands. Conglomerates and conglomeratic sands commonly lie directly on Paleozoic rocks but occur locally in all sand units of the Twin Mountains Formation. Conglomerate pebbles and granules are well rounded and commonly polished; sand grains are subround to subangular.

The Glen Rose Formation, which separates sand and clay sequences of the Twin Mountains and Paluxy Formations, consists of alternating beds of limestone (argillaceous, silty, or dolomitic) and calcareous silts and clays. Massive, thicker, more indurated limestone beds (up to 15 feet thick) occur chiefly in the lower part of the formation. Outcrop of the Glen Rose forms a narrow band and slight escarpment from central Wise, through southeastern Jack, western Parker, and northern and western Erath counties (Pl. I). In the extensive outcrop area within the drainage area of the Brazos River in Hood, Somervell, and eastern Erath counties, alternating limestones and calcareous clays form a prominent bench- and terrace-topography; prairies are developed locally. The formation crops out in wide to narrow belts along the drainage of the Leon River in southeastern Comanche, Hamilton, and Coryell counties and in a narrow belt along Cow House Creek in Hamilton and Coryell counties. Extensive prairies are supported by the Glen Rose in southwestern Comanche, eastern Brown, and northern Mills counties.

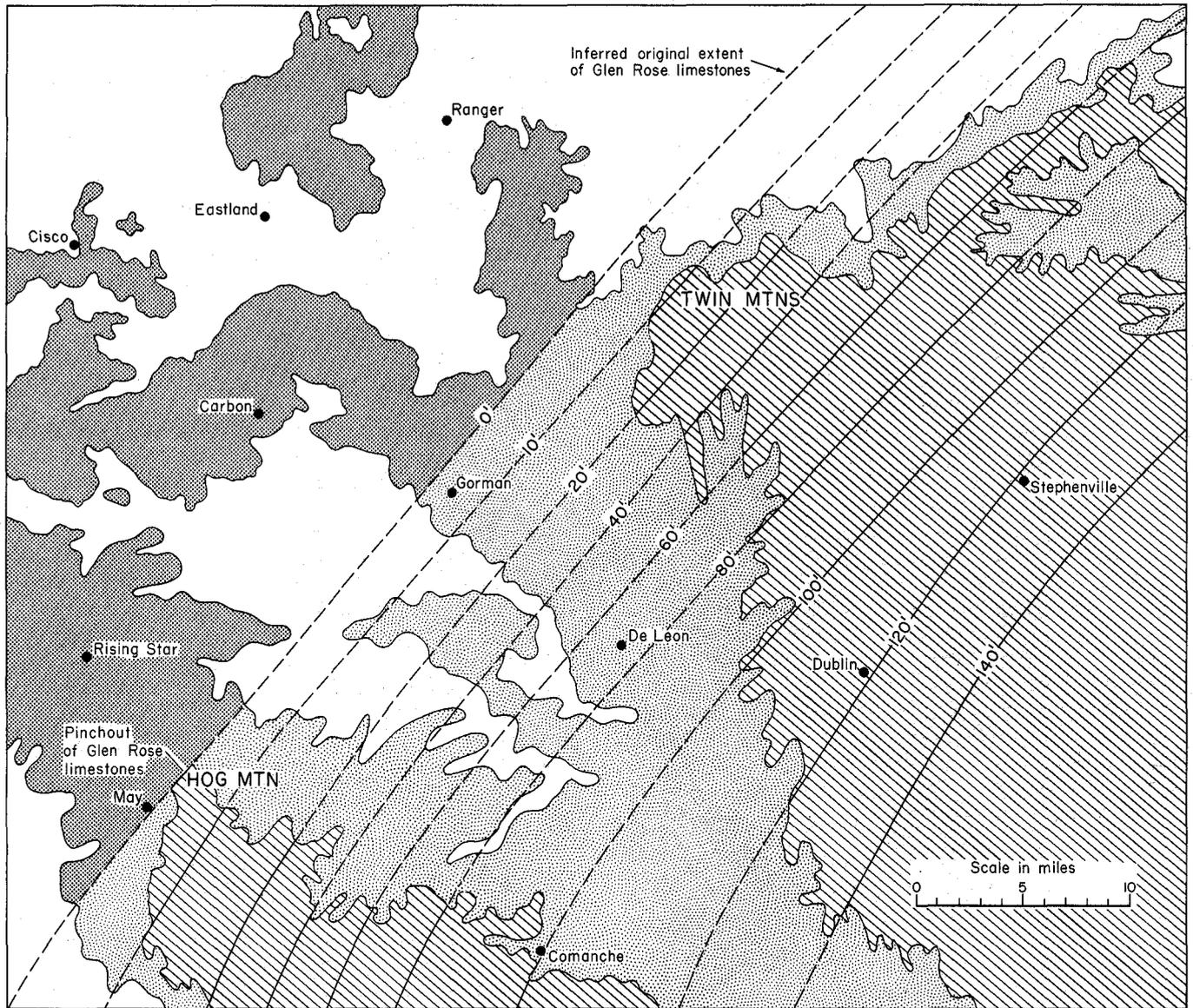
Limestones of the Glen Rose Formation pinch out or grade laterally to sands and clays westward and northward from North-central Texas. Sand and clay sequences, in part coextensive with limestone sequences of North-central Texas, can be recognized in North and West-central Texas, though limestones are absent in these marginal sequences. The Glen Rose Formation increases in thickness basinward or to the southeast, from about 10 feet in westernmost exposures (*e.g.*, eastern Eastland and western Erath counties) to about 600 feet in down-dip sections exposed along the Colorado River and approximately 800 feet in subsurface basinal sequences of central McLennan County. Glen Rose isopachs trend northeast-southwest (fig. 2), similar to those of the Twin Mountains Formation and its basinal equivalents. Contact of the Twin Mountains and Glen Rose Formations is gradational throughout North-central Texas; upper units of the Twin Mountains grade laterally to limestones and clays of the Glen Rose in down-dip sections. Contact of the Glen Rose

with overlying sands and clays of the Paluxy Formation commonly is abrupt in North-central Texas.

Uppermost sands of the Lower Cretaceous sequence of North-central Texas are included in the Paluxy Formation, which crops out in southern Wise, northwestern Tarrant, Parker, Hood, Somervell, Erath, northern Bosque, Hamilton, southern Comanche, northern Coryell, and eastern Mills counties (Pl. I). The outcrop belt supports postoak and blackjack oak and is commonly designated the Paluxy Cross Timbers; sandy loam soils are developed on the formation.

The Paluxy Formation consists of sand, silt, and clay, and, locally, impure limestone. The formation varies from light gray to red, though it is commonly lighter colored than the Twin Mountains Formation. Sands are fine to very fine grained and well sorted to very well sorted, with better sorting and smaller grain size toward the south. Sand units are cross-bedded on moderate to large scale, laminated, or massive; they are generally poorly cemented and friable, though a few beds are indurated locally. Individual sand units range upward in thickness to 20 feet. Associated clays are sandy and silty and laminated; red or maroon clays are not as common as in the Twin Mountains Formation. The Paluxy is about 250 feet thick in northernmost outcrops (southern and central Wise County), decreasing in thickness southward; trend of isopach lines of the Paluxy (including coextensive units in the Antlers Formation of North and West Texas) is roughly east-west, different from the northeast-southwest trends shown by other Lower Cretaceous units (fig. 2). With southward thinning, the Paluxy interfingers and grades laterally into fossiliferous clays and limestones of the overlying Walnut Formation and locally the underlying Glen Rose Formation. The southern limit of Paluxy sands in outcrop is marked approximately by a line extending southwestward from Waco (McLennan County) to Burnet (Burnet County); at about this line the Paluxy is replaced by the Walnut Formation.

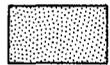
West-central Texas. —The Glen Rose Formation, separating sands and clays of the Twin Mountains and Paluxy Formations in North-central Texas, thins westward and grades laterally to sand and clay. The limestone beds which delineate the Glen Rose can be mapped northward to the area east of May and north of Hog Mountain in northern Brown and northwestern Comanche counties (Pl. I). In northwesternmost outcrops (northwestern Erath and eastern Eastland counties) the Glen Rose Formation is about 5 to 15 feet thick. Westward, in the nearest complete section of basal Cretaceous rocks (at Spring Mesa in southeastern Callahan County), the Glen Rose Formation is absent. By means of preserved area of pinch-out



EXPLANATION



Glen Rose Formation  
(outcrop and subcrop)



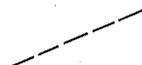
Twin Mountains Formation



Antlers Formation



Isopachs on Glen Rose Formation



Reconstructed isopachs



Fig. 3. Pinch-out and inferred original extent of Glen Rose Formation in western part of North-central Texas.

(northeastern Brown County and central Wise County) and thickness trends of Glen Rose limestones, the original extent of the Glen Rose can be reconstructed (fig. 3). The line marking inferred original extent of the Glen Rose is used to delineate arbitrarily the undifferentiated West-central Texas basal Cretaceous sequence (Antlers Formation) from the differentiated North-central Texas sequence (Twin Mountains, Glen Rose, and Paluxy Formations).

The Antlers Formation of West-central Texas forms extensive, rolling sand roughs along the upper reaches of the Leon River drainage (Leon River, Sabana River, and Copperas Creek) of Eastland and the eastern part of Callahan counties. Westward along the Callahan Divide the Antlers forms the lower slope of buttes, mesas, and small plateaus made up of Cretaceous rocks that rise above the general surface of outcropping Paleozoic rocks. Principal outcrops, within the area of study, are in Callahan, central and northwestern Coleman, northeastern Runnels, Taylor, Nolan, Coke, and Tom Green counties (Pl. 1).

The Antlers Formation of West-central Texas varies in thickness owing chiefly to variations in the pre-Cretaceous depositional surface. Along the Callahan Divide the Antlers thins uniformly westward from nearly 300 feet in southeastern Callahan County to about 80 feet in central Nolan County. The basal Cretaceous sequence thins southward, as shown in sections in Coleman, northeastern Runnels, Coke, and Tom Green counties as well as in sections along the northern edge of the Edwards Plateau just south of the mapped area (Pl. I). It pinches out and is overlapped by Fredericksburg formations in west-central Coleman County (north of Talpa and Valera) and in southeastern Tom Green County. These areas mark a northern extension of a regional, pre-Cretaceous topographic high, supported by massive Permian limestones, and centering in eastern Schleicher, eastern Sutton, western Kimble, and western Menard counties. This high is connected to the regional topographic high of the Llano Uplift by a broad crest through northern Menard and southern McCulloch counties.

Along the Callahan Divide in Callahan and Coleman counties westward to Howard County, Antlers Formation consists of three, generally persistent and distinct, units: (1) a lower conglomeratic sand, (2) a middle, chiefly red silty clay, and (3) an upper sand unit (Pl. II and fig. 4). The lower sand is characteristically medium to coarse grained, conglomeratic, moderately to well sorted, cross-bedded on a moderate scale, and buff to locally light gray though commonly stained superficially by wash from overlying red clay. Gravel in the lower unit is similar to gravel

in the Twin Mountains Formation of North-central Texas. It occurs as distinct conglomerate beds or scattered through the sand and consists of well-rounded, pebble- to cobble-size fragments of quartz and varicolored chert. The middle unit of the Antlers Formation consists commonly of silty, poorly bedded clays, chiefly red but locally maroon, yellow, and gray; these locally grade laterally to argillaceous, varicolored siltstones. The upper unit contains fine- to medium-grained, well-sorted, buff to gray, cross-bedded to massive sands, and light gray to yellow-gray, silty and sandy clays. Coarser grained sands and local pebble conglomerates occur in the lower part of the unit; clays and fine-grained sands are more common in the upper part. Conglomerates are not as common as in the lower unit. A few of the sand beds are slightly indurated and some weather to concretionary masses.

South of the Callahan Divide, clays, especially lighter colored clays, make up greater parts of the Antlers Formation. In thin sections (30 feet or less) such as those in southeastern Tom Green County, the entire basal Cretaceous sequence consists of silty and sandy clay. Conglomerates are not as common as in sections along the Callahan Divide, but where they are present consist of siliceous gravel like that characteristic of the lower part of the Antlers and Twin Mountains Formations. Calcareous gravel, characteristic of basal Cretaceous rocks on the eastern or opposite flanks of the Llano Uplift, is absent, suggesting a regional southwest drainage pattern during deposition. As thickness and lithology change, units recognized along the Callahan Divide are less distinctive (Pl. II).

The three units of the West-central Texas Antlers Formation are considered analogous to the Twin Mountains—Glen Rose—Paluxy sequence of North-central Texas, though correlations are not definite (fig. 4). The lower unit of the Antlers Formation is similar to sands of the Twin Mountains Formation; the upper unit is similar to the Paluxy Formation; both sand units of the West-central Texas sequence are progressively coarser grained and more poorly sorted westward than analogous stratigraphic units of North-central Texas. The middle clay unit of the Antlers is possibly continuous with parts of the Glen Rose and Twin Mountains Formations of North-central Texas. At Spring Mesa (Callahan County), Santa Anna Mountain (Coleman County), and locally at Table Mountain (northeastern Runnels County) thin, calcareous siltstones occur within the middle clay unit of the Antlers and are possibly marginal equivalents of Glen Rose limestones (Pl. II). Red clays of the middle unit of the Antlers of West-central Texas are similar to red clays included in the upper part of the Twin Mountains Formation

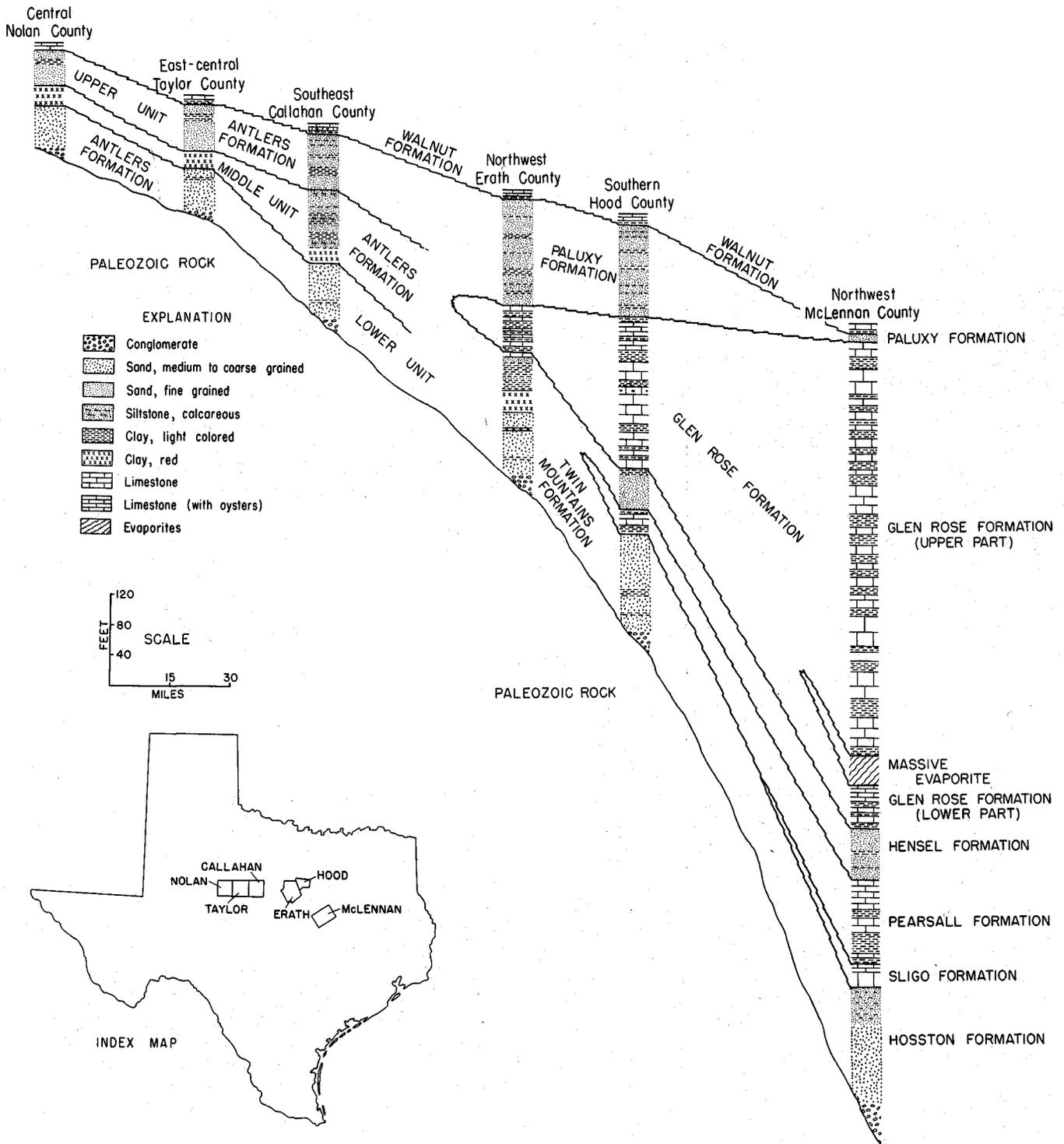


Fig. 4. Stratigraphic relationship of Antlers Formation of West-central Texas and Lower Cretaceous sequence of North-central Texas.

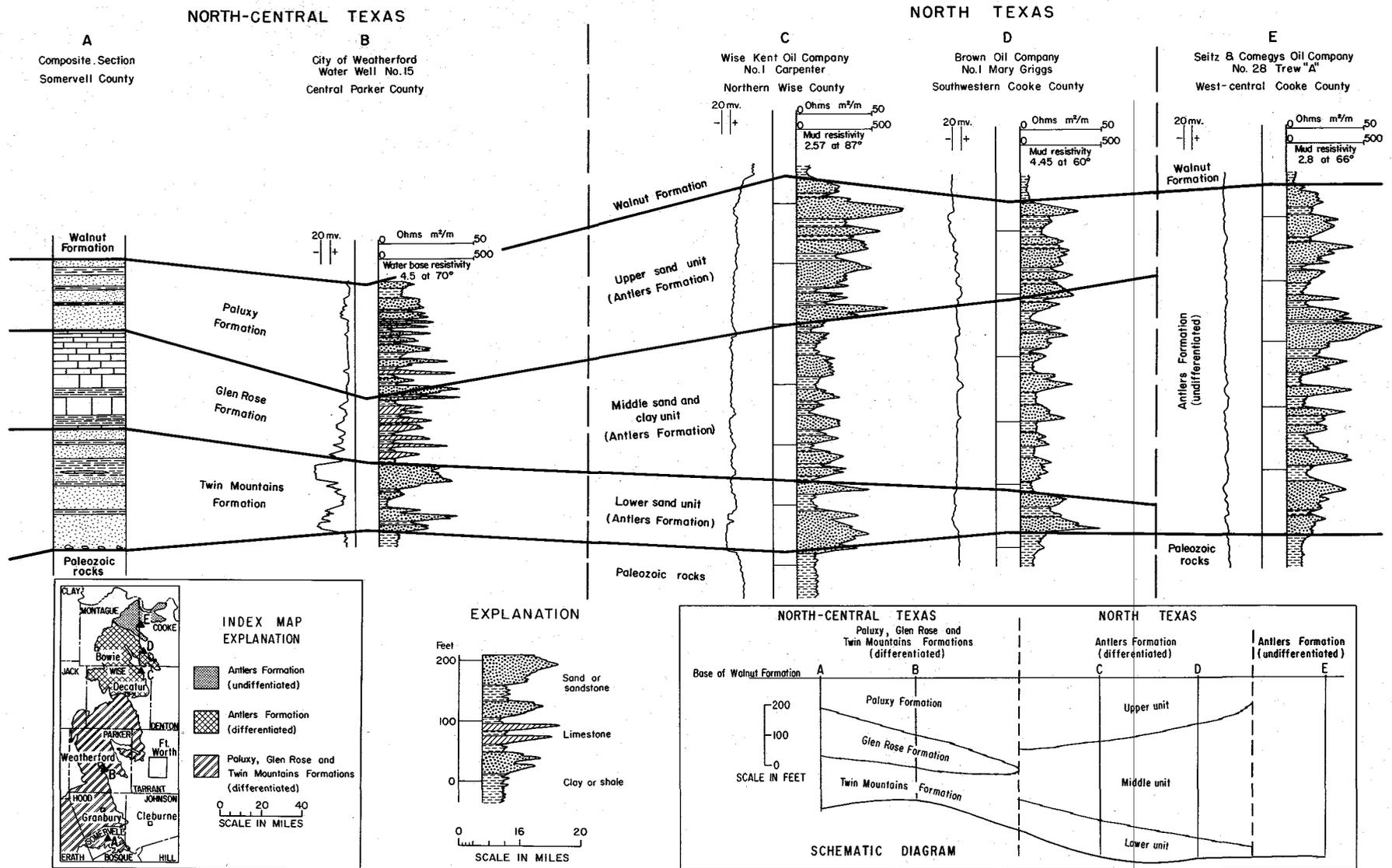


Fig. 5. Stratigraphic relationship of Antlers Formation of North Texas and Lower Cretaceous sequence of North-central Texas.

in North-central Texas. Stratigraphic relations of the West-central Texas Antlers Formation to the basal Cretaceous sequence of North-central Texas are shown in figure 4.

North Texas.—Limestones of the Glen Rose Formation thin northward in the same manner they thin westward (Pl. I). They can be mapped northward to an area just north of Decatur (central Wise County), beyond which limestones and clays of the Glen Rose are replaced by sands and clays of the middle part of the Antlers Formation. For convenience, the boundary between the undifferentiated basal Cretaceous sequence of North Texas (Antlers Formation) and the differentiated sequence (Twin Mountains, Glen Rose, and Paluxy Formations) of North-central Texas is drawn at the latitude of Decatur, immediately south of the zone of pinch-out, across a relatively narrow and regular belt of outcrop of basal Cretaceous rocks (Pl. I); this is a cartographic consideration and avoids placement of the boundary in the irregular area of outcrop (along drainage of Catlet Creek) at the latitude of Glen Rose pinch-out.

The Antlers Formation of North Texas forms a gently rolling surface and supports post oak, blackjack oak, and other vegetation of the Western (or Upper) Cross Timbers. The belt of outcrop is extensive in northern Wise and Montague counties and extends southeastward along Clear Creek into western Cooke and northwestern Denton counties and along Elm Fork of the Trinity River and North and South Fish Creeks into northwestern Cooke County.

The Antlers Formation of North Texas varies in thickness from 550 to 650 feet and is thicker than strata assigned to this formation in West-central Texas. In northern Wise and southern Montague counties, the formation is divided into three units (fig. 5): (1) a lower conglomeratic sand, (2) a middle clay and sand, and (3) an upper sand. The lower sand unit is equivalent to part of the Twin Mountains Formation of North-central Texas; it is about 125 feet thick in northern Wise County, comparable to thickness of the Twin Mountains Formation in the southern part of the county. The lower unit consists chiefly of medium-grained, moderately sorted, massive to locally cross-bedded quartz sand. One to three beds of siliceous conglomerate, made up of granule- and pebble-size fragments of quartz, quartzite, and varicolored chert, occur at the base; the gravel is clean with only a little clay, silt, or sand matrix. The middle unit of the Antlers consists mostly of yellow, purple, and variegated clays with interbedded fine- to very fine-grained, very well-sorted sand. This unit occupies a stratigraphic position analogous to limestones and clays of the Glen Rose Formation and possibly to clays and sands of the

upper part of the Twin Mountains and lower part of the Paluxy Formations. It makes up 40 percent of the Antlers Formation in northern Wise County, increasing to about 60 percent of the formation in southern Montague County. The upper unit of the Antlers Formation in northern Wise and southern Montague counties consists of fine-grained, moderately well-sorted, massive to cross-bedded sands interbedded with clays similar to those of the middle unit. It decreases in thickness from about 230 feet in northern Wise County (slightly thinner than the Paluxy Formation of southern Wise County) to 150 feet in southern Montague County and is equivalent to most or all of the Paluxy Formation to the south. In northern Montague and northern Cooke counties, near the Red River, the Antlers Formation consists of approximately 500 feet of interbedded fine-grained sand and light gray to varicolored clays, with basal siliceous conglomerates. Units of the formation in northern Wise and southern Montague counties cannot be recognized. The upper part of the Antlers Formation is well exposed in bluffs along the Red River (fig. 6).

Central Texas.—Only a small area of the basal Cretaceous sequence characteristic of Central Texas crops out within the area of this study. These are strata assigned to the Travis Peak Formation, exposed from Salt Creek northeast of Brownwood in east-central Brown County south through central Mills County to the latitude of Goldthwaite, and in outliers of basal Cretaceous rocks in west-central and south-central Brown County and northwestern Mills County (Pl. I). The Travis Peak is overlain by limestones and clays of the Glen Rose Formation and sands and clays of the Paluxy Formation.

The Travis Peak Formation within the mapped area consists of coarse conglomerates, medium- to coarse-grained sands, red silty clays, and impure limestones. As such it is a facies distinct from the Twin Mountains Formation. Conglomerates of the Travis Peak consist chiefly of dolomite and limestone pebbles and cobbles derived from rocks of the Llano Uplift. In addition to the different lithic composition, gravels of the Travis Peak conglomerates generally are larger in size than gravels of Twin Mountains and Antlers conglomerates (fig. 7). Sands of the Travis Peak are medium to coarse grained, light colored to red, and cross-bedded to massive; they contain a heavy mineral suite characterized by a relative abundance of garnet derived from rocks of the Llano Uplift. Sands are locally absent in the Travis Peak and generally more common in northern sections along outcrop. Clays are chiefly red, very silty or sandy, and generally indistinctly or poorly bedded. Impure limestone sections up to 50 feet thick occur locally in southern Brown and

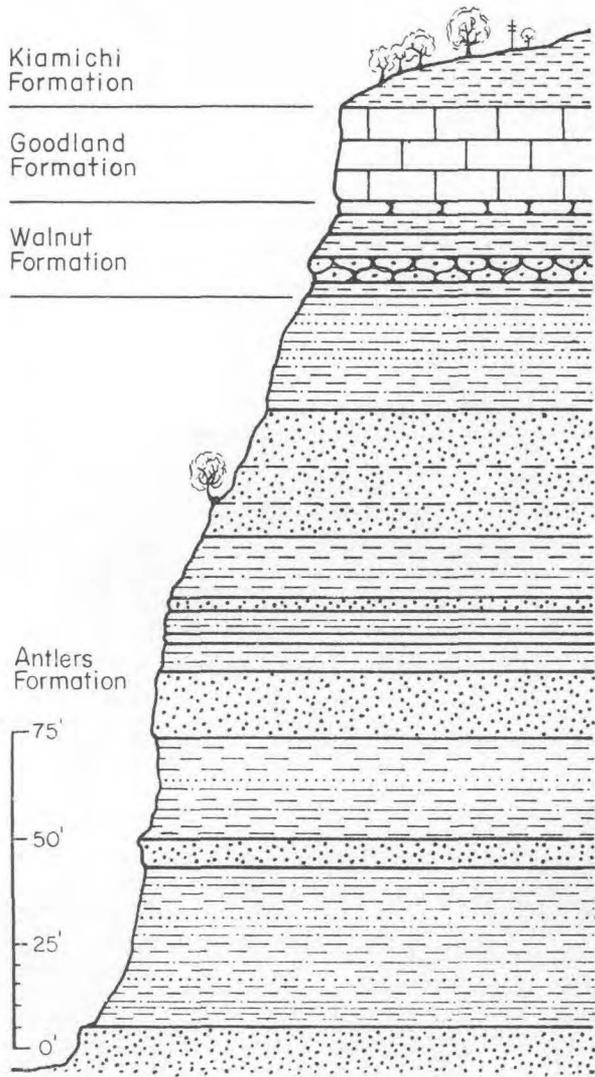


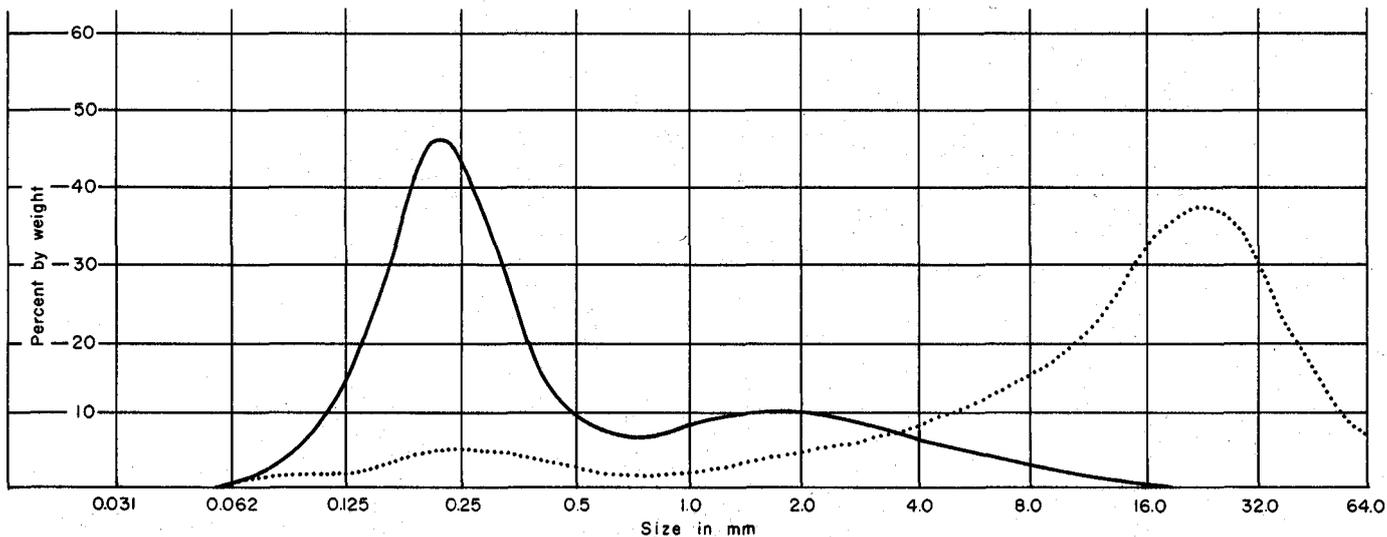
Fig. 6. Lower Cretaceous sands (Antlers Formation) exposed in bluff along Red River, Cooke County, Texas.

northern Mills counties (P1 II). These limestones are gray buff to red, very sandy and silty, and locally conglomeratic. They occur in the middle part of the Travis Peak Formation, a position analogous to the Cow Creek Limestone of Travis County (in outcrop) and basal sequences eastward (subsurface), and may be marginal facies of that unit. The Travis Peak within the mapped area is variable in thickness, ranging upwards to

200 feet. South of the mapped area the unit is locally overlapped by higher formations with the Glen Rose or younger Cretaceous formations lying directly on pre-Cretaceous rocks. Thickness variations are due to deposition of basal Cretaceous rocks in this region on the irregular, pre-Cretaceous topography of the Llano Uplift. Stratigraphic relationship of the Central Texas and North-central Texas basal Cretaceous sequences is shown in figure 8.

ROCK COMPOSITION

|                          |      |                                              |      |
|--------------------------|------|----------------------------------------------|------|
| CALCAREOUS CONGLOMERATES |      | SILICEOUS CONGLOMERATES<br>(2-8 mm fraction) |      |
| Limestone                | 52 % | Quartz                                       | 42 % |
| Dolomite                 | 13 % | Chert (polished)                             | 40 % |
| Chert                    | 15 % | Chert (unpolished)                           | 15 % |
| Quartz                   | 20 % | Miscellaneous aggregates                     | 3 %  |



EXPLANATION

- Siliceous conglomeratic sands  
Antlers and Twin Mountains Formations
- Calcareous conglomerates  
Travis Peak Formation

Fig. 7. Particle-size distribution and rock composition of representative basal Cretaceous conglomerates and conglomeratic sands. (Modified from Damon, MS.)

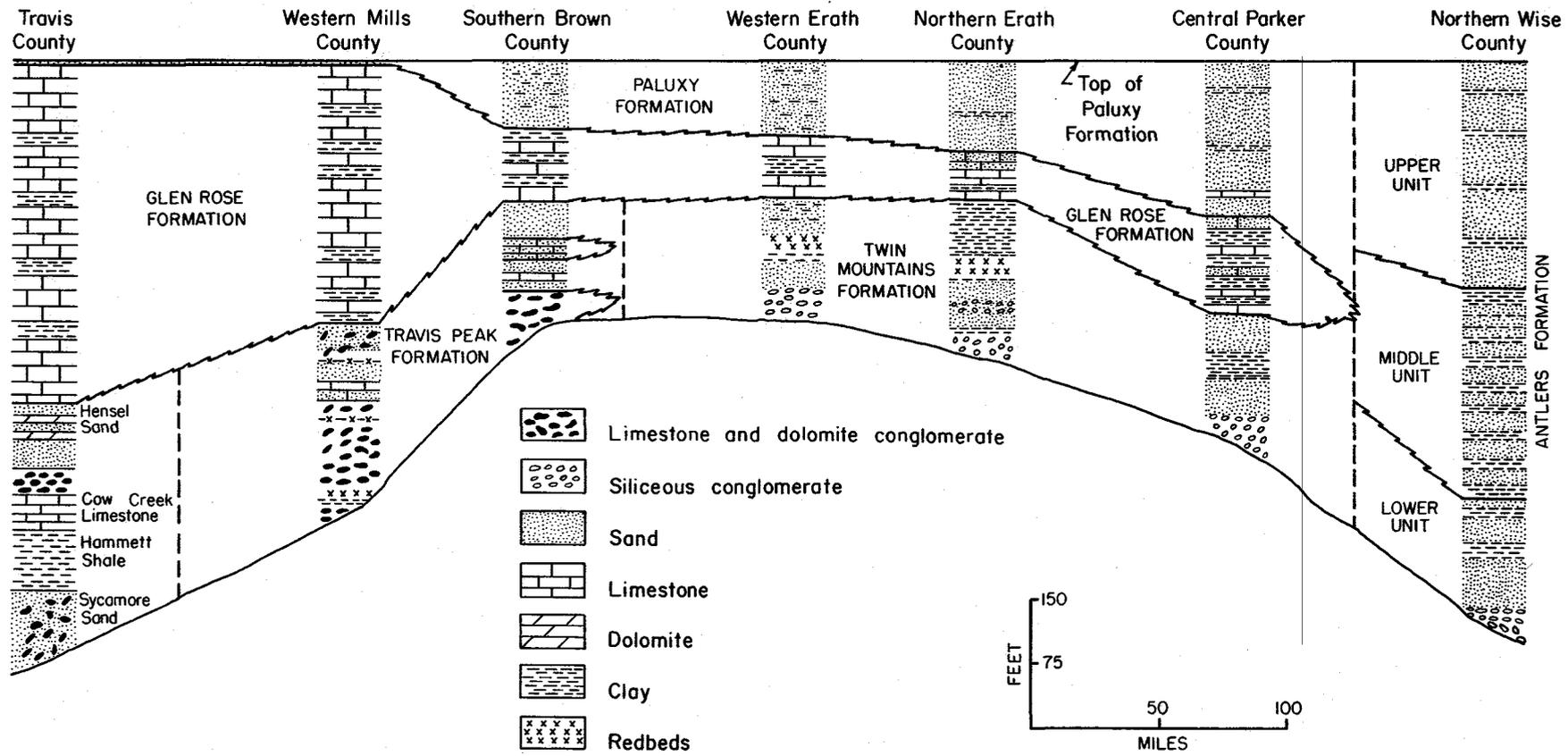
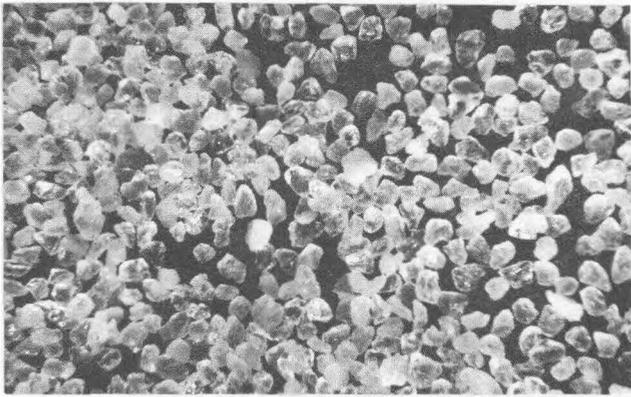
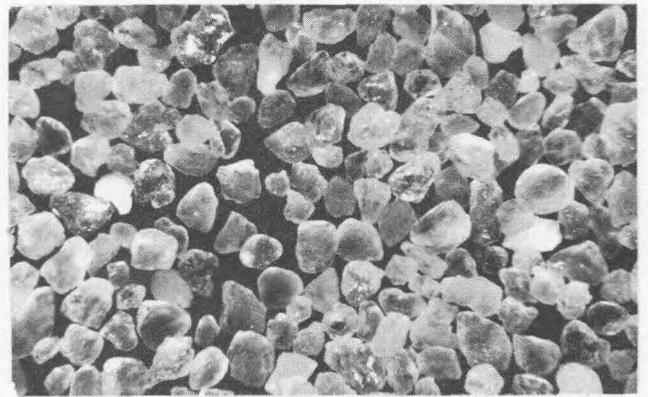


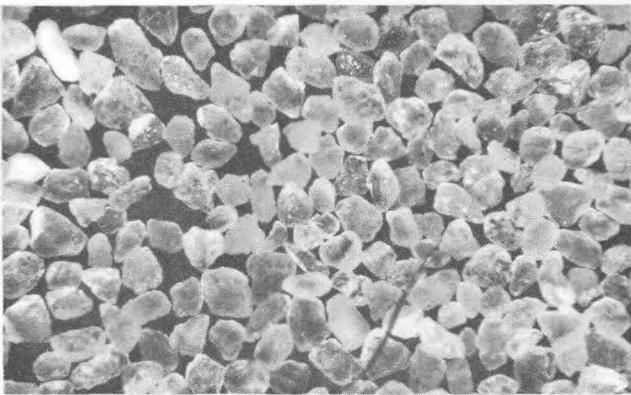
Fig. 8. Stratigraphic relationship of Lower Cretaceous sequences of North-central and Central Texas.



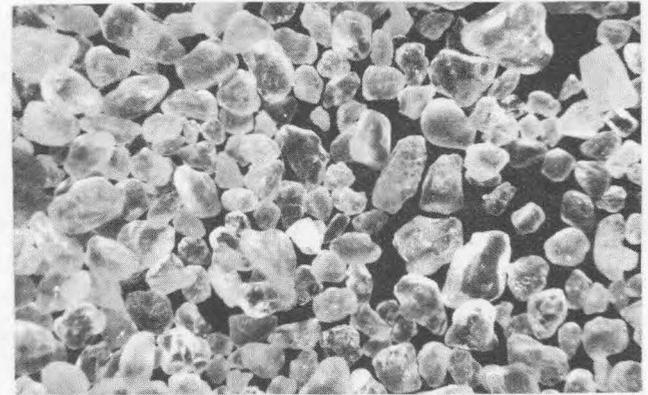
Paluxy Formation (south facies)



Paluxy Formation (north facies)



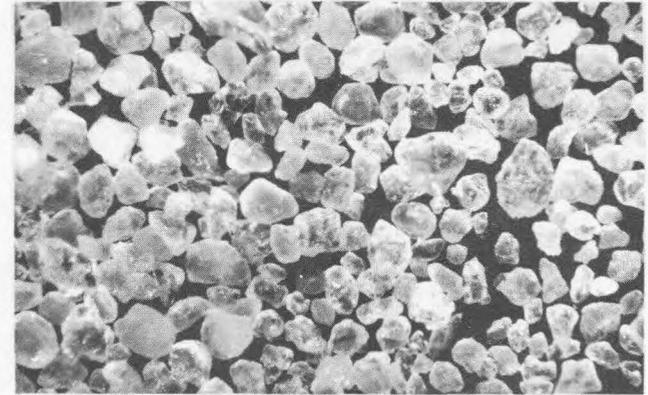
Twin Mountains Formation (upper unit)



Antlers Formation (North Texas, upper unit)



Twin Mountains Formation (lower unit)



Antlers Formation (North Texas, middle unit)



Antlers Formation (West-central Texas)



Antlers Formation (North Texas, lower unit)

Fig. 9. Photomicrographs of representative Lower Cretaceous sands; all x50.

PHYSICAL, MINERAL, AND CHEMICAL PROPERTIESGrain Size and Distribution

Two trends characterize grain size of Lower Cretaceous sands of North-central, North, and West-central Texas: (1) mean grain size decreases vertically in all sequences and (2) mean grain size increases westward and northward in individual stratigraphic units (Pl. III). The lower stratigraphic units, Twin Mountains Formation and lower part of the Antlers Formation, are coarser grained; the upper units, Paluxy Formation and upper part of the Antlers Formation, are finer grained (fig. 9). The percent of clay- and silt-sized sediments correspondingly is higher in upper units than in lower units and lower in westward and northward sequences than those in North-central Texas. Thus, a higher yield of sand-size grains generally occurs from deposits made up of coarser grained particles. In addition, degree of sorting and grain-size distribution correlate with regional trends in mean grain size (Pl. III). The better sorted sands or those with narrower ranges in grain-size distribution generally have lower mean grain sizes; the poorer sorted sands generally have broad or variable ranges in grain-size distribution and have higher mean grain size. The fine-grained and better sorted sands are well rounded; the medium- to coarse-grained and poorly sorted sands commonly are angular to subrounded.

Sands in the Paluxy Formation of North-central Texas average about 0.14 mm in mean grain size of the +200-mesh fraction (fig. 9). Yield of sand-sized particles is about 75 percent from most samples with generally less than 50 percent of the grains retained on a 140-mesh screen. Paluxy sands are well sorted to very well sorted. Sands of the upper sand unit of the Twin Mountains Formation of North-central Texas likewise are fine grained and well sorted but generally slightly coarser in grain size than sands of the Paluxy (fig. 9). Mean grain size averages about 0.18 mm; yield of sand-sized particles is about 90 percent with approximately 50 percent of the grains retained on a 100-mesh screen. The coarsest grained sands from Lower Cretaceous rocks of North-central Texas are from the lower sand unit of the Twin Mountains Formation (fig. 9). Mean grain size of these sands is about 0.28 mm with yield of sand-sized particles generally exceeding 90 percent. About 80 percent of the grains are retained on a 100-mesh screen and nearly 30 percent are retained on a 60-mesh screen. These sands are moderately sorted to moderately well sorted. The Antlers Formation of West-central Texas contains moderately well-sorted sands with average mean grain size of about 0.22 mm (fig. 9). Sands from the lower part of this formation are

coarsest, commonly with mean grain size as much as 0.35 mm; those from the upper part of the unit generally are finer grained. Yield of sand-sized particles generally exceeds 90 percent with about 70 percent retained on a 100-mesh screen. The Antlers Formation of North Texas consists of a lower coarse-grained unit, a middle very fine-grained unit, and an upper fine-grained unit (fig. 9). Average mean grain size from all units is approximately 0.17 mm. Yield averages about 75 percent with about 30 percent retained on a 100-mesh screen.

Particles larger than sand size occur throughout the Twin Mountains Formation of North-central Texas and the Antlers Formation of North and West-central Texas. Chief concentration of the gravel fraction is in the lower parts of these units.

Mineral Composition

Lightweight minerals (specific gravity of 2.85 or less) constituting Lower Cretaceous sands are chiefly quartz (ordinary quartz and chert), with minor amounts of feldspar, calcite, dolomite, and clay minerals. Ordinary quartz is the chief constituent, generally making up more than 98 percent of sand samples; it is transparent with vitreous or high luster and well-developed conchoidal fracture. A few of the more rounded grains are slightly frosted. A minor amount of quartz is cloudy or tinted yellow and red by small inclusions of hematite or other iron minerals. Chert is mainly white, with minor amounts yellow, red, and blue black; it is opaque to translucent. In the finer grained sands chert makes up less than 1 percent of the total but locally may constitute up to 5 percent of the coarser grained or conglomeratic sands. Sands containing siliceous pebbles or sands overlying conglomerate beds not only contain higher percentages of chert but also contain greater varieties of chert (red, yellow, black). These coarse-grained and conglomeratic sands are most common in lower units of the Antlers, Twin Mountains, and Travis Peak Formations. Feldspar is much less common than chert in Lower Cretaceous sands, though it locally makes up 1 percent or slightly more of the sand-size fraction. Sand-size fragments of dolomite and limestone occur locally in sands of the Travis Peak Formation, especially sands associated with dolomite- and limestone-pebble conglomerates. Clay minerals commonly form matrix to Lower Cretaceous sands or occur as sand-size aggregates.

Heavy minerals (specific gravity greater than 2/85) in Lower Cretaceous sands are predominantly

common stable varieties. Tourmaline, zircon, and ilmenite predominate; staurolite, rutile, hematite, and magnetite are common; garnet, topaz, fluorite, and other less common varieties are found locally. The heavy mineral suite of the Twin Mountains Formation and lower units of the Antlers Formation is generally more varied than that of the Paluxy sands. Zircon and staurolite are more abundant in western sections of Lower Cretaceous sands; magnetite, ilmenite, and hematite increase in abundance eastward (Sidwell, 1947). Sands of the Travis Peak Formation generally have higher percentages of garnet and hematite than other Lower Cretaceous sands; they commonly contain flakes of altered biotite and chlorite.

Heavy minerals generally make up less than 0.5 percent and commonly less than 0.1 percent of Lower Cretaceous sands. Heavy mineral content of washed, +200-mesh fractions of 60 sand samples averaged about 0.032 percent; the highest percent of heavy minerals occurs in finer grained sands (Paluxy sands average 0.040 percent) and lowest concentrations occur in coarser grained sands (Twin Mountains and Antlers sands average 0.025 percent) (see Appendix B, Results of Tests).

#### Chemical Composition

Lower Cretaceous sands of North-central, North, and West-central Texas are practically nonmineralic, made up chiefly of quartz. Accord-

ingly, the main chemical component is silica; in most samples silica comprises more than 98 percent of the total compounds. Content of alumina depends mainly on amount of clay minerals and to a much smaller extent on amount of feldspar present with the sand; clay is largely removed by washing. The amount of alumina remaining after simple washing generally is less than 0.7 percent (Appendix B). Titanium oxide occurs largely as a component of the heavy mineral ilmenite, which is common in very small amounts in most samples. Content of titanium oxide is greatest in the finer grained sands, smallest in the coarser grained sands; it is commonly less than 0.03 percent of the total sample. Calcium oxide and magnesium oxide occur in some samples and are absent in others; in most of the sands combined content of these compounds does not exceed 0.1 percent (Appendix B). The principal and most objectionable impurity is iron, present chiefly as an oxide (limonite, hematite, or magnetite). Iron impurities occur in one or more of the following forms: (1) as a component of heavy minerals, chiefly magnetite and ilmenite, (2) as discrete particles and stains of limonite and other iron-oxide minerals, (3) as ferruginous clay adhering to individual quartz sand grains, (4) as a component of discrete, dark-colored chert grains, and (5) as locked grains and inclusions. Iron content, expressed as an oxide, is less than 0.1 percent (after simple washing) in most Lower Cretaceous sands with about 15 percent of total samples analyzed (Appendix B) containing 0.04 percent or less iron oxide—the maximum content tolerated for many industrial uses.

## RESOURCES

Definition and Utilization

The terms specialty sand, industrial sand, and silica sand are applied to sands used for purposes other than construction (aggregate, ballast, and fill). Unit prices are higher and specifications more rigid for industrial sands than for constructional sands, but consumption and production are much smaller. Specialty sands are composed chiefly of silica in the form of quartz; they must be physically sound and chemically inert.

Specialty and industrial sands are classified according to use; principal types are: (1) abrasive sands, including blast sand, sawing sand, and grinding sand; (2) glass and chemical sands, including soluble silicates, silicon carbide, and ferrosilicon; (3) metallurgical sands used as silica alloys or as fluxes; (4) refractory and foundry sands, including core sand, furnace-bottom sand,

gannister mix, molding sand, runner sand, and placing sand; (5) filter-media sands; (6) hydraulic-fracturing sands; and (7) engine or traction sands. Finely ground silica sand or other silica materials (silica flour and pulverized sand) are used chiefly as fillers in such products as paint, paste-wood filler, hard rubber, stucco plaster, gypsum plaster board, asphaltic mixtures, and autoclave cement products.

Specifications

Specifications for industrial sands generally vary from one consumer to another, depending on the requirements of the end user. Representative specifications are outlined in table 2. For glass and chemical manufacturing, amount and kind of nonsilica impurities are critical; amount of iron oxide, alumina, base oxides, and alkalis is also

Table 2. General specifications and requirements for various types of industrial and specialty sands (from Fisher, 1965; Murphy, 1960).

| Use                                                   | PHYSICAL REQUIREMENTS                 |                                                                      |                                                                          |                                                   | CHEMICAL REQUIREMENTS                                                                                                                                          |
|-------------------------------------------------------|---------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                       | Grain shape                           | Grain size                                                           | Particle-size distribution                                               | Miscellaneous                                     |                                                                                                                                                                |
| Blast sand                                            | Rounded                               | -4 to +100 mesh for various grades                                   | Narrow range for specified grades, e. g., -4 to +12 mesh, -4 to +30 mesh | Sound and durable, free of adhering iron and clay | Clean and relatively low in non-silica impurities                                                                                                              |
| Glass grinding sand                                   | Rounded                               | -30 to +100 mesh for various grades                                  | Uniform, well sorted                                                     | Sound and durable, free of adhering clay and iron | Clean and relatively low in non-silica impurities                                                                                                              |
| Sawing and rubbing sand                               | Free from flat grains                 | -12 to +100 mesh                                                     | Uniform, well sorted                                                     | Sound and durable, free of adhering clay and iron | Clean and relatively low in non-silica impurities                                                                                                              |
| Glass sand                                            | Angular grains may improve fusibility | -30 to +140 to locally +200 mesh                                     | Narrow range, well sorted                                                | Consistent composition                            | Fe <sub>2</sub> O <sub>3</sub> , <0.02 to 0.025% (flint glass), <1.0% (amberglass); Al <sub>2</sub> O <sub>3</sub> , <0.2%; CaO + MgO, <0.05%; alkalis, <0.01% |
| Chemical silica, sodium silicate, and silicon carbide | Angular grains may improve fusibility | -30 to +140 mesh<br>-20 to +80 mesh (soluble silicates)              | Narrow range, well sorted                                                |                                                   | Specifications same as glass sand, except Fe <sub>2</sub> O <sub>3</sub> not as critical (<0.05) in sodium silicates                                           |
| Foundry core sand                                     | Not critical                          | -30 to +140 mesh                                                     | More than 90% -40 to +100 mesh                                           | High permeability, high sintering point           | Inert                                                                                                                                                          |
| Foundry furnace bottom sand                           | Not critical                          | -3 mesh to clay                                                      | Wide range desirable                                                     | Clay bond naturally or added                      | Inert                                                                                                                                                          |
| Processed molding sand                                | Not critical                          | Variable, specified by user                                          | 90% distributed over 4 adjacent sieves                                   | High sintering point                              | Inert                                                                                                                                                          |
| Coal washing sand                                     | Subangular to rounded                 | -30 to +140 mesh                                                     | 90% -30 to +100 mesh                                                     | Specific gravity not less than 2.64               | Free from clay and organic matter                                                                                                                              |
| Filter media sand                                     | Less than 1% flat grains; rounded     | Fine: 0.35 to 0.45 mm<br>Medium: 0.45 to 0.55 mm<br>Coarse: >0.55 mm | Uniform, well sorted                                                     | Durable                                           | Free from clay and organic matter; <5.0% soluble                                                                                                               |
| Hydraulic-fracturing sand                             | Highly rounded                        | -16 to +60 mesh for various grades                                   | Critical, well sorted, e. g., >80% -20 to +40 mesh                       | Maximum specific gravity of 2.7 desirable         | Inert, free from clay and organic matter                                                                                                                       |
| Traction sand                                         | Low sphericity; angular               | -20 to +70 mesh                                                      | Uniform, well sorted                                                     |                                                   | Free from clay                                                                                                                                                 |
| Ceramic sand (ground)                                 | Angular                               | 98% -200 mesh                                                        |                                                                          |                                                   | <0.05% Fe <sub>2</sub> O <sub>3</sub>                                                                                                                          |

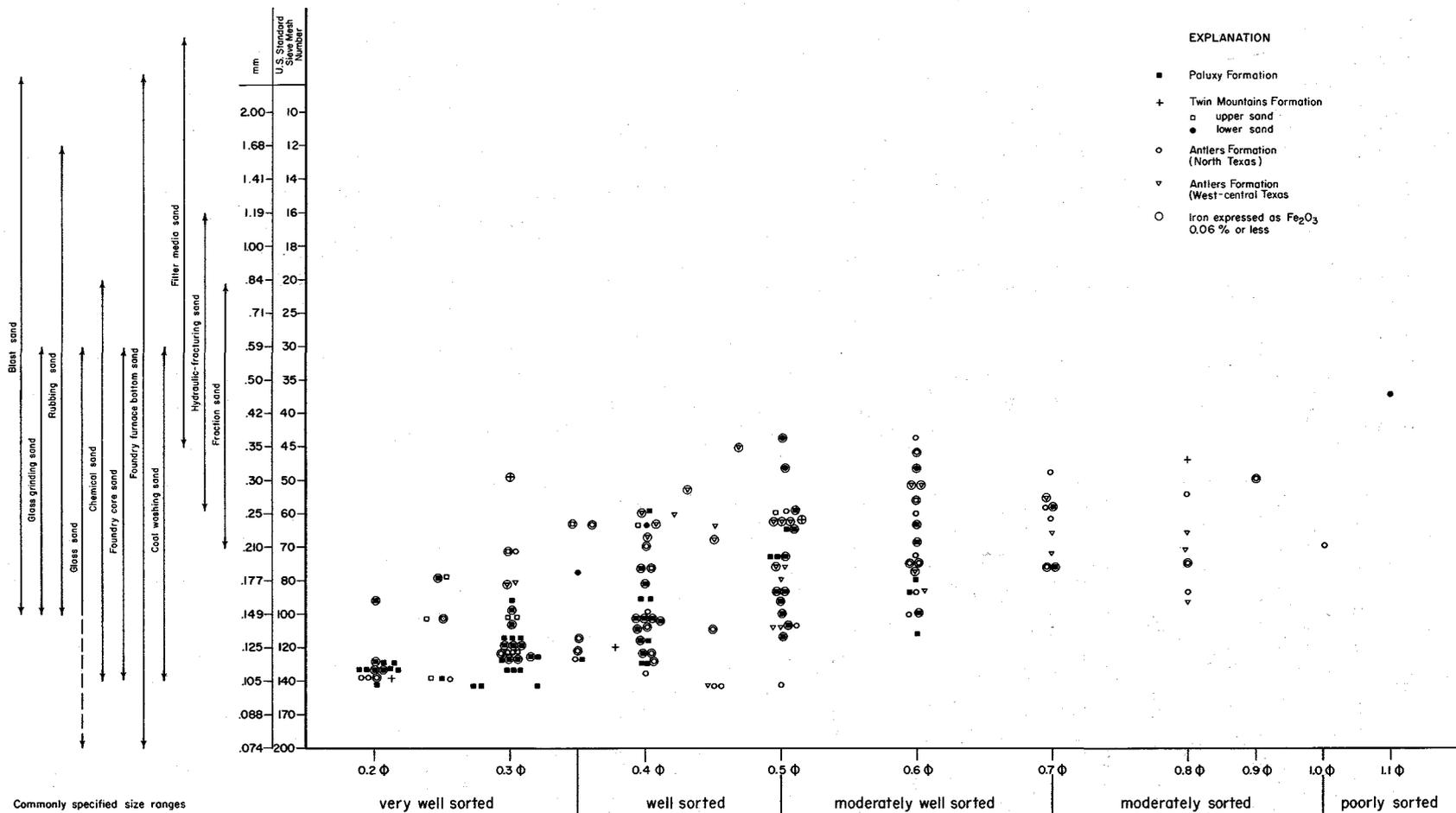


Fig. 10. Distribution of Lower Cretaceous sands based on mean grain size and sorting, compared to commonly specified size ranges for selected industrial uses.

limited. Physical specifications, in addition to soundness and durability, are based largely on grain size and distribution; uniform or narrowly specified particle-size distribution is commonly required. Shape of individual grains is not critical except in hydraulic-fracturing and certain abrasive sands where rounded to highly rounded and highly spherical grains commonly are specified. Shape is significant as it affects melting in glass batches or permeability and strength in molding sands.

#### Quality and Beneficiation

The quality of most Lower Cretaceous sands in Texas is marginal, judged in terms of principal uses and specifications. Two factors are involved: grain size and chemical composition. Small grain size alone eliminates certain of the sand deposits as potential industrial sands. Evaluation of approximately 150 samples of Lower Cretaceous sands in terms of specifications outlined in table 2 shows that the mean grain size of many falls below or within the lower part of specified size ranges (fig. 10).

Chemical purity is a second limiting factor. After simple washing, iron commonly is present in amounts greater than the maximum specified for most industrial uses. Only about 15 percent of the samples analyzed contained 0.04 percent or less iron oxide, the maximum amount tolerated for such uses as glass sand. However, nearly 50 percent of the samples analyzed contained 0.06 percent or less iron oxide, suggesting that some sort of beneficiation process could probably upgrade many deposits to meet existing specifications. Chief source of iron contamination in Lower Cretaceous sands is iron oxide (limonite and hematite) occurring as interstitial material, as discrete particles, or as coatings on quartz grains. Most effective commercial processes for reducing the amount of iron in this form are attrition scrubbing and acid washing. Dark-colored chert, a source of iron contamination in many sands, is not common in Lower Cretaceous sands except locally; electrostatic processing, designed to separate chert and ordinary quartz, therefore would be impractical in these cases. Certain heavy minerals, especially magnetite, commonly are a source of iron contamination in silica sands; heavy minerals make up only a small fraction of Lower Cretaceous sand samples and are sufficiently fine grained to be practically eliminated by simple water classification; total amount of heavy minerals (not all iron-bearing minerals) is less than 0.1 percent in washed and water-classified samples (see Appendix B). Heavy media separation or flotation generally would not

be warranted, where concentrations of iron-bearing heavy minerals are low.

#### Mining and Processing

Lower Cretaceous sand deposits of North, West-central, and North-central Texas are amenable to open-pit mining. The sands are generally unconsolidated or only slightly coherent so that only a minimum amount of blasting is necessary. Overburden in large parts of North-central and North Texas likewise is unconsolidated, though most of the sand deposits in the Callahan Divide of West-central Texas and the Lampasas Cut Plain of North-central Texas are overlain by hard limestones. At the recent sand operation at Santa Anna in Coleman County, up to 80 feet of overburden including about 45 feet of hard limestone were removed.

Most of the Lower Cretaceous sand deposits can be mined in pits with conventional excavation equipment, such as front-end loaders, or by hydraulic dredges in which sand is pumped as a slurry through pipes to classifiers from a dredge located in a wet pit. Milling and processing of these sands for several specialty or industrial uses require only simple washing, classifying or screening, and drying. A few deposits are of such quality that only simple processing is necessary for production of such products as glass sand, though most of the sands require more complex processing and beneficiation for use as glass or chemical-grade sand. Plants should be designed to separate clay and fines, reduce iron content to acceptable minimums, and reduce or separate such impurities as chert, heavy minerals, and organic matter. Clay and fine fractions can be removed through use of liquid-cyclone separators, rake- and screw-classifiers, or by decanting in settling basins. Attrition scrubbing of sands as high-solid slurries is effective in reducing iron stains and coatings on individual grains. Iron-bearing heavy minerals in some sands probably can be removed on concentrating tables, in magnetic separators, and by flotation. Electrostatic separation probably is necessary to remove iron-bearing chert, which has a specific gravity too near that of quartz to be removed by gravity separation. However, neither heavy minerals nor iron-bearing chert is common in Lower Cretaceous sands.

In the production of silica flour or pulverized sand, silica sands are commonly dry ground in conical mills, short-tube mills, long-tube mills, short ball and pebble mills. Air separation is utilized with the ground product falling into three general mesh sizes of -140 mesh, -200 mesh, and

-325 mesh. Silica sands generally are not wet ground due to the additional cost of drying.

Specialty sands used in relatively small quantities or intermittently (blast, filter, and hydraulic-fracturing sands) and ground silica sand generally are marketed in bags; other sands commonly are shipped in bulk.

#### Production, Consumption, and Value

Sands used for industrial and specialty purposes are only a small part of total sand production (7 percent by quantity and 20 percent by value for the United States and 2.6 percent by quantity and 14 percent by value for Texas). Annual production of industrial sands in Texas is about 340,000 short tons valued at nearly \$2 million (table 3). All principal types of industrial sands are produced in the State; those used as abrasives, blast sand, glass sand, and hydraulic-fracturing sand comprise about 85 percent of total production.

Main producing areas and principal industrial sand products in the State are (fig. 11): southeast Texas, including Polk, Liberty, Hardin, and San Jacinto counties (blast and foundry sands); Voca, McCulloch County (hydraulic-fracturing sand and silica flour); Bexar County (blast, foundry, and hydraulic-fracturing sands); Columbus, Colorado County (foundry, abrasive, and engine sand); East Texas (Freestone, Smith, Upshur, and Wood counties) (foundry sand), and

Kosse, Limestone County (glass sand and silica flour). Glass sand was produced for several years at Santa Anna (Coleman County), but this operation was abandoned in 1964. Production of silica flour and other grades of industrial sand began in 1964 in Somervell County, west of Cleburne.

In recent years ground silica sand or silica flour has been imported, chiefly from Oklahoma and Arkansas. Currently, silica flour is produced within the State in McCulloch, Somervell, and Limestone counties.

Most of the industrial sand produced in Texas is consumed within the State; in addition about 200,000 tons of industrial sand are shipped into the State each year. Imports come mainly from the Mill Creek District in southern Oklahoma, with smaller amounts from the Guion District in northeastern Arkansas and districts in the Midwestern States. These imports are consumed largely as glass sand, silica flour, and special foundry sands.

Annual consumption of industrial sand in Texas is about 600,000 to 700,000 tons. Main uses, in approximate order of amount, are as follows: glass sand, blast and abrasive sand, hydraulic-fracturing sand, silica flour, foundry and molding sand, engine sand, and miscellaneous sand. Principal markets or points of consumption of glass sand, used both in the manufacture of plate and container glass, are located at Corsicana, Houston, Palestine, and Waco, and at Shreveport,

Table 3. Production and value of different grade sands in Texas (data from U. S. Bureau of Mines Minerals Yearbook and unpublished commodity data sheets).

|                                    | <u>Texas</u> |             |
|------------------------------------|--------------|-------------|
|                                    | <u>1963</u>  | <u>1964</u> |
| <b>Constructional sand:</b>        |              |             |
| Quantity (thousand short tons)     | 11,565       | 12,382      |
| Value (thousand dollars)           | 10,825       | 11,825      |
| Average value (dollars per ton)    | 0.93         | 0.96        |
| <b>Industrial sand (unground):</b> |              |             |
| Quantity (thousand short tons)     | 497          | 336         |
| Value (thousand dollars)           | 1,824        | 1,929       |
| Average value (dollars per ton)    | 3.68         | 5.74        |

Louisiana. Silica sand is also used as a ceramic material in the manufacture of fiberglass at Waxahachie in Ellis County. Abrasive and blast sands are marketed throughout the State but chiefly in industrial and metropolitan areas. Silica flour is used in certain chemical industries, such as the manufacture of soluble silicates, and as mineral fillers, primarily at Hillsboro (Hill County), Dallas, and Houston. Hydraulic-fracturing sand and engine sand are marketed widely in the State. Consumption of foundry sand is largely in East and Southeast Texas.

Average value of industrial sand produced in Texas during 1964 was \$5.74 per short ton compared to an average value of \$0.96 per short ton for constructional sand (tables 3 and 4). Value of Texas industrial sand is slightly higher than the U. S. average value due to a relatively large production of higher-unit value products, such as blast sand and hydraulic-fracturing sand. Value of ground silica or silica flour produced in Texas is not released by operating companies; U. S. average value of ground silica during 1963 was slightly more than \$7.50 per short ton.

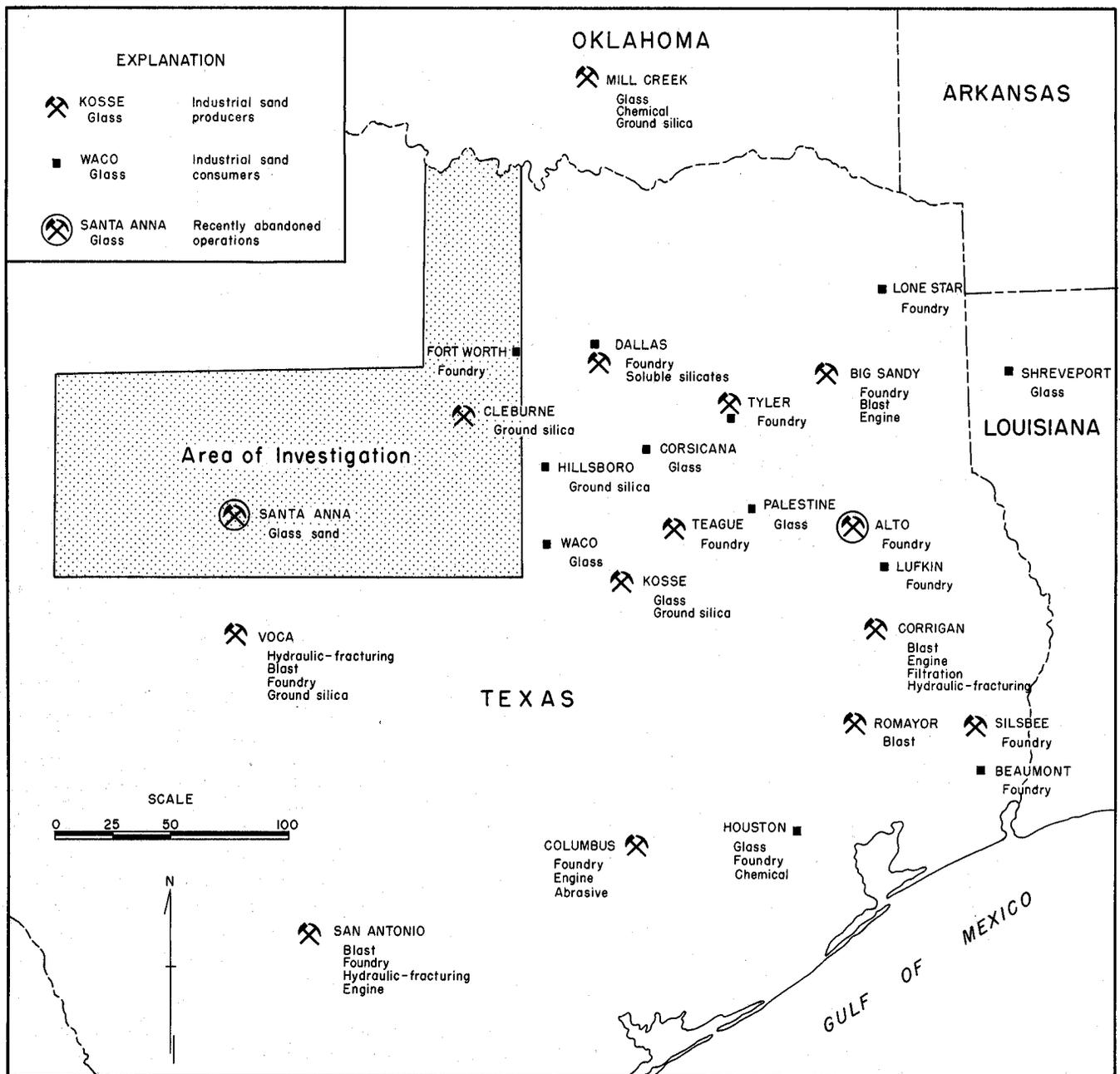


Fig. 11. Location of area of investigation in relation to principal industrial sand producers and consumers.

Table 4. Average value of industrial sands produced in United States  
(1963 data from U. S. Bureau of Mines Minerals Yearbook).

| <u>Industrial sand (unground)</u> | <u>Average value per ton</u> | <u>Industrial sand (ground)</u> | <u>Average value per ton</u> |
|-----------------------------------|------------------------------|---------------------------------|------------------------------|
| Glass                             | \$3.28                       | Abrasives                       | \$ 7.32                      |
| Molding                           | 2.75                         | Chemicals                       | 11.01                        |
| Grinding and polishing            | 2.14                         | Enamels                         | 11.28                        |
| Blast sand                        | 4.50                         | Fillers                         | 7.72                         |
| Fire or furnace                   | 1.91                         | Foundry uses                    | 7.40                         |
| Engine                            | 1.98                         | Glass                           | 6.75                         |
| Filtration                        | 2.54                         | Pottery, porcelain or tile      | 10.40                        |
| Oil (hydrofrac)                   | 6.35                         | Unspecified                     | 10.39                        |
| Other                             | 2.74                         | Average                         | 8.58                         |
| Average                           | 3.00                         |                                 |                              |

#### Summary of Principal Deposits and Economic Considerations

Evaluation of Lower Cretaceous sands as sources and potential sources of industrial sands must consider initially (1) the quality of the deposits, especially in terms of grain size and chemical purity, (2) location of the deposits in relation to existing or potential markets and to transportation facilities to these markets, and (3) location of the deposits in relation to existing industrial sand producers. Of the 114 deposits tested and analyzed (Appendix B), 33 contain sands of quality suitable for some industrial use. Judged from chemical purity and grain-size distribution these deposits are grouped in three categories: very good, good to very good, and good (table 5). Those classed as very good deposits contain 0.04 percent or less iron oxide (within specified limits for ceramic and chemical uses) and have more than 65 percent of grains retained on a 100-mesh screen (a particle-size distribution meeting specified size ranges for most industrial sand uses). The two other groups of principal deposits include those which contain iron oxide in excess of 0.04 percent but not more than 0.08 percent (within possible commercial limits of beneficiation) and have at least 50 percent of grains retained on a 100-mesh screen. The list of principal deposits (table 5) is based only on deposits sampled and tested (Appendix B)

and as such is incomplete; other deposits of comparable quality are certainly present.

The Paluxy Formation generally contains sands with lower content of iron oxide than other Lower Cretaceous formations; many of these sands, especially those in outcrop south of the Brazos River, are very fine grained and commonly mixed with relatively large amounts of clay- and silt-sized particles. Northward along outcrop of the Paluxy, grain size of sediments increases so that in the area roughly between the Brazos River and the northernmost occurrence of the Paluxy (Pl. 1) several deposits are of suitable quality; best quality deposits are in eastern Parker and western Tarrant counties. Other Lower Cretaceous sands—in the Twin Mountains Formation of North-central Texas and the Antlers Formation of North and West-central Texas—generally are coarser grained than the Paluxy but also slightly higher in content of iron oxide. Several deposits within these units are of good to very good quality but are not restricted to any particular area of outcrop.

The second important consideration of Lower Cretaceous sands as industrial sands is location of the deposits in reference to existing and potential markets. At the present time one important area of industrial sand consumption is in eastern North-central Texas, chiefly between Dallas-Fort

Table 5. Tabulation and evaluation of principal industrial sand deposits (Lower Cretaceous) of North-central, North, and West-central Texas. See Appendix B for specific tests, location, and description of deposits.

## Key:

Chemical purity

Very good: 0.04% or less  $Fe_2O_3$   
 Good: 0.06% or less  $Fe_2O_3$   
 Fair: 0.07 to 0.08%  $Fe_2O_3$

Grain size

Very good: more than 65% retained on 100-mesh screen  
 Good: 50 to 65 % retained on 100-mesh screen

| Deposit                                   | Chemical purity | Grain size        | Thickness of usable sand (feet) | Overburden       |                                | Stripping ratio | Distance by road to railroad (miles) |
|-------------------------------------------|-----------------|-------------------|---------------------------------|------------------|--------------------------------|-----------------|--------------------------------------|
|                                           |                 |                   |                                 | Thickness (feet) | Nature                         |                 |                                      |
| <u>Very Good Quality Deposits</u>         |                 |                   |                                 |                  |                                |                 |                                      |
| Callahan 1                                | very good       | very good         | 45                              | none             |                                | 0:1             | 9.3                                  |
| Cooke 3                                   | very good       | good to very good | 10                              | 3                | consolidated                   | 1.8:1           | 13.5                                 |
| Nolan 4                                   | very good       | very good         | 20                              | 15               | unconsolidated                 | 0.1:1           | 8.5                                  |
| Nolan 6                                   | very good       | very good         | 10                              | 2                | unconsolidated                 | 0.3:1           | 8.0                                  |
| Parker 5                                  | very good       | very good         | 20                              | 3                | unconsolidated to consolidated | 2.5:1           | 8.6                                  |
| Tarrant 2                                 | very good       | very good         | 38                              | 10               | unconsolidated                 | 1:1             | 5.6                                  |
|                                           |                 |                   |                                 | 5                | consolidated                   |                 |                                      |
|                                           |                 |                   |                                 | 32               | unconsolidated                 |                 |                                      |
| <u>Good to Very Good Quality Deposits</u> |                 |                   |                                 |                  |                                |                 |                                      |
| Callahan 2                                | very good       | good              | 40                              | 20               | unconsolidated                 | 0.5:1           | 9.2                                  |
| Coleman 1                                 | very good       | good              | 30                              | 60               | consolidated                   | 2.5:1           | 0.1                                  |
| Comanche 4                                | good            | good to very good | 20n                             | 15               | unconsolidated                 | 0.5:1           | 7.2                                  |
| Cooke 1                                   | good            | very good         | 8                               | 10               | unconsolidated                 | 6.3:1           | 3.3                                  |
| Cooke 4                                   | good            | very good         | 18                              | 5                | consolidated                   | 1.7:1           | 8.8                                  |
| Erath 3                                   | very good       | good              | 12                              | 25               | unconsolidated                 | 0.3:1           | 11.7                                 |
| Erath 12                                  | good            | very good         | 15                              | 4                | unconsolidated                 | 1:1             | 0.7                                  |
| Erath 18                                  | good            | very good         | 8                               | 15               | unconsolidated                 | 2.5:1           | 6.3                                  |
| Erath 20                                  | good            | very good         | 50                              | 20               | unconsolidated                 | 1.5:1           | 15.0                                 |
| Hood 4                                    | good            | very good         | 20                              | 75               | unconsolidated                 | 0.2:1           | 9.9                                  |
| Montague 2                                | good            | very good         | 15                              | 3                | unconsolidated                 | 0:1             | 16.2                                 |
| Montague 8                                | very good       | good              | 25                              | none             |                                | 0.4:1           | 2.9                                  |
| Nolan 1                                   | good            | very good         | 10                              | 10               | unconsolidated                 | 0:1             | 7.6                                  |
| Parker 2                                  | very good       | good              | 12                              | 3                | unconsolidated                 | 0.3:1           | 2.1                                  |
| Parker 6                                  | good            | very good         | 10                              | 10               | consolidated                   | 2.5:1           | 11.7                                 |
| Parker 7                                  | very good       | good              | 12                              | 15               | unconsolidated                 | 0.7:1           | 12.9                                 |
| Parker 21                                 | good            | very good         | 20                              | 3                | consolidated                   | 0.3:1           | 1.4                                  |
| Parker 28                                 | very good       | good              | 25                              | 5                | unconsolidated                 | 0.6:1           | 11.3                                 |
| Tarrant 1                                 | very good       | good              | 15                              | 15               | consolidated to unconsolidated | 1:1             | 15.0                                 |
| Wise 2                                    | good            | very good         | 25                              | 10               | unconsolidated                 | 0.4:1           | 4.4                                  |
| <u>Good Quality Deposits</u>              |                 |                   |                                 |                  |                                |                 |                                      |
| Cooke 1A                                  | good            | good              | 10                              | 20               | unconsolidated                 | 2:1             | 3.4                                  |
| Erath 8                                   | good            | good              | 12                              | 5                | consolidated                   | 1.3:1           | 3.7                                  |
| Erath 10                                  | fair            | very good         | 20                              | 10               | unconsolidated                 | 0:1             | 15.0                                 |
| Nolan 3                                   | fair to good    | very good         | 60                              | none             |                                | 1.2:1           | 7.8                                  |
| Parker 12                                 | good            | good              | 12                              | 60               | unconsolidated                 | 0.3:1           | 9.8                                  |
| Parker 19                                 | good            | good              | 15                              | 3                | unconsolidated                 | 0.7:1           | 16.8                                 |
| Taylor 1                                  | fair            | good to very good | 30                              | 7                | consolidated                   | 0.6:1           | 6.2                                  |
|                                           |                 |                   |                                 | 3                | unconsolidated                 |                 |                                      |
|                                           |                 |                   |                                 | 15               | unconsolidated                 |                 |                                      |

Worth and Waco (fig. 12). In this area, which is situated entirely east of the easternmost occurrence of outcropping Lower Cretaceous sands, silica or industrial sands, both ground and unground, are used in the manufacture of glass, fiberglass, soluble silicates, and autoclave cements, and as foundry sand. Only those deposits occurring in the eastern part of Lower Cretaceous

sand outcrop are favorably situated to this market. Development of Lower Cretaceous sand deposits in West-central Texas (e.g., Callahan, Nolan, and Taylor counties) probably depends on development of a market within that area, as the deposits are distant from the North-central Texas consuming area.

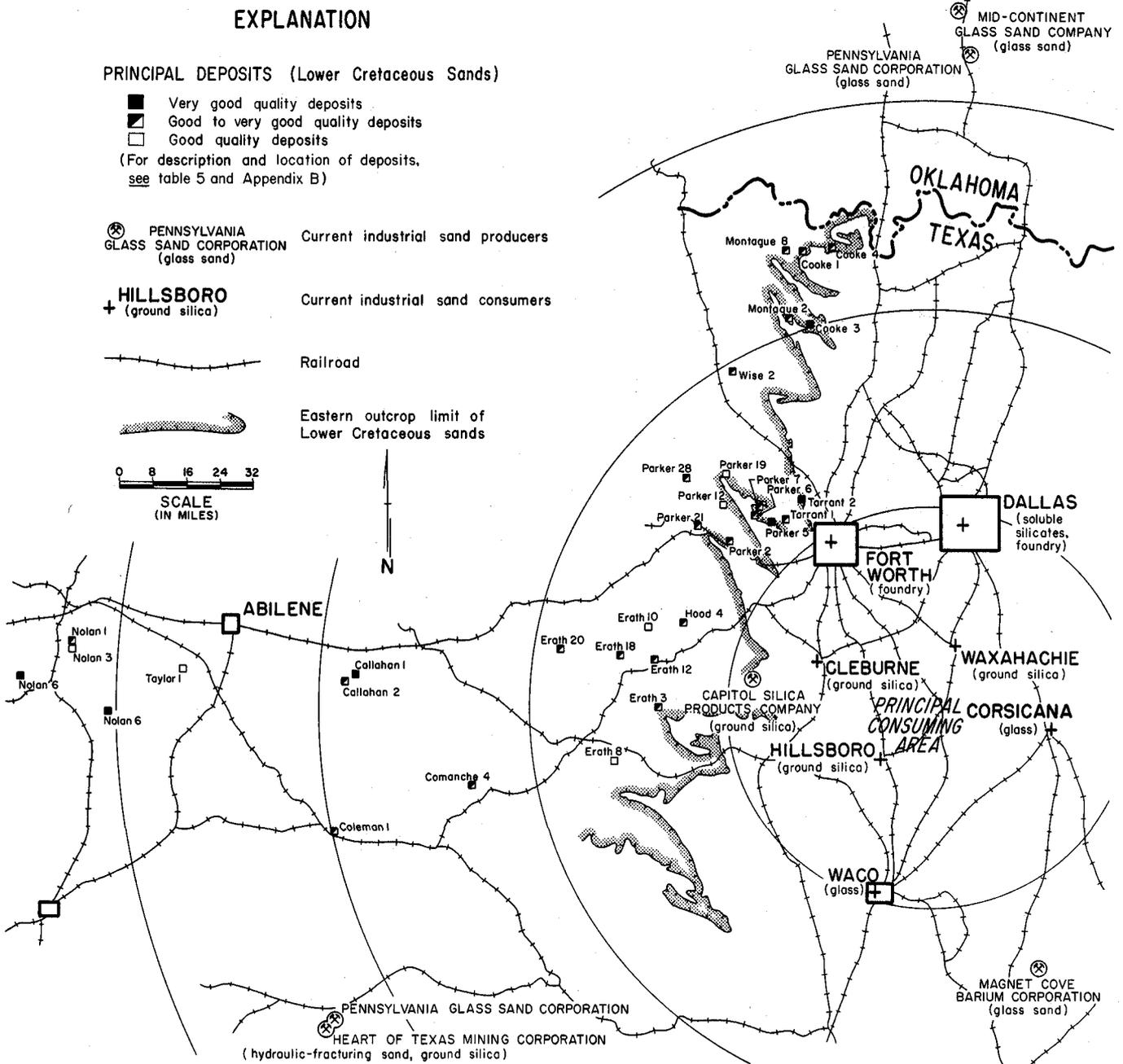


Fig. 12. Location and distribution of principal Lower Cretaceous sand deposits in relation to existing North-central Texas market area.

The existing North-central Texas market for industrial sands is supplied chiefly by producers in Texas and Oklahoma, as indicated in figure 12. Only one of these producers, Capitol Silica Products Company, utilizes Lower Cretaceous sands. Until recently, Lower Cretaceous sands were processed as glass sands from Coleman County by the Santa Anna Silica Sand Company; this operation was abandoned in 1964. Pennsylvania Glass Sand Corporation and Heart of Texas Mining Corporation process hydraulic-fracturing sand and ground silica from Hickory (Cambrian) sands in

McCulloch County, Magnet Cove Barium Corporation obtains glass sand and silica flour from Wilcox (Eocene) sands in Limestone County, and Pennsylvanian Glass Sand Corporation and Mid-Continent Glass Sand Corporation mine glass sand, silica flour, and other industrial sands from lower Paleozoic sands in the Mill Creek District of southern Oklahoma. Delivery costs and quality of industrial sands now supplied to the North-central Texas market area are additional factors to be considered in any planned development of Lower Cretaceous sand deposits.

## BIBLIOGRAPHY

- Adkins, W. S. (1933) The Mesozoic Systems in Texas, in Sellards, E. H., Adkins, W. S., and Plummer, F. B., The geology of Texas, Vol. I, Stratigraphy: Univ. Texas Bull. 3232 (Aug. 22, 1932), pp. 239–518.
- Atlee, W. A. (1962) The Lower Cretaceous Paluxy Sand in Central Texas: Baylor Geol. Studies, Bull. 2, 26 pp.
- Barnes, V. E. (1948) Ouachita facies in Central Texas: Univ. Texas, Bur. Econ. Geology Rept. Invest. No. 2, 15 pp.
- \_\_\_\_\_, and Schofield, D. A. (1964) Potential low-grade iron ore and hydraulic-fracturing sand in Cambrian sandstone, northwestern Llano region, Texas: Univ. Texas, Bur. Econ. Geology Rept. Invest. No. 53, 58 pp.
- Beede, J. W., and Bentley, W. P. (1918) The geology of Coke County: Univ. Texas Bull. 1850, 83 pp.
- \_\_\_\_\_, and Waite, V. V. (1918) The geology of Runnels County: Univ. Texas Bull. 1816, 64 pp.
- Boone, P. A. (1965) The stratigraphy and depositional history of the Trinity sands, Central Texas: Thesis Defense Field Conference, Baylor Univ., field trip guidebook (unpublished), 20 pp.
- Bullard, F. M., and Cuyler, R. H. (1930) A preliminary report on the geology of Montague County, Texas: Univ. Texas Bull. 3001, pp. 57–75.
- Bybee, H. P., and Bullard, F. M. (1927) The geology of Cooke County, Texas: Univ. Texas Bull. 2710, pp. 5–61.
- Cartwright, L. D., Jr. (1932) Regional structure of Cretaceous on Edwards Plateau of southwest Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 16, pp. 691–700.
- Cheney, M. G., and Eargle, D. H. (1951) Geologic map of Brown County, Texas: Univ. Texas, Bur. Econ. Geology County Geologic Map.
- Damon, H. G. (1940) Cretaceous conglomerates on the east side of the Llano Uplift, Texas: Ph. D. dissertation, Univ. Iowa, 90 pp.
- \_\_\_\_\_. (MS.) Geology and glass sand resources of the Trinity Group in North-central Texas: Univ. Texas, Bur. Econ. Geology (open-file report).
- Drake, N. F., and Thompson, R. A. (1893) Report on the Colorado coal field of Texas: Texas Geol. Survey 4th Ann. Rept. (1892), pp. 357–448.
- Fisher, W. L. (1965) Industrial and specialty sands, in Rock and mineral resources of East Texas: Univ. Texas, Bur. Econ. Geology Rept. Invest. No. 54, pp. 204–266.
- \_\_\_\_\_, and Rodda, P. U. (1966) Nomenclature revision of basal Cretaceous rocks between the Colorado and Red Rivers, Texas: Univ. Texas, Bur. Econ. Geology Rept. Invest. No. 58, 20 pp.
- Folk, R. L. (1961) Petrology of sedimentary rocks: Hemphill's Book Store, Austin, Texas, 154 pp.
- Garner, L. E. (MS.) Sand resources of Texas Gulf coast.
- Henderson, G. G. (1928) The geology of Tom Green County: Univ. Texas Bull. 2807, 116 pp.
- Hendricks, Leo (1957) Geology of Parker County, Texas: Univ. Texas Pub. 5724, 67 pp.
- Hill, R. T. (1890) A brief description of the Cretaceous rocks of Texas and their economic uses: Texas Geol. Survey 1st Ann. Rept. (1889), pp. 105–141.
- \_\_\_\_\_. (1894) Geology of parts of Texas, Indian Territory, and Arkansas adjacent to Red River: Bull. Geol. Soc. Amer., vol. 5, pp. 297–338.
- \_\_\_\_\_. (1901) Geography and geology of the Black and Grand Prairies, Texas: U. S. Geol. Survey 21st Ann. Rept., pt. 7, 666 pp.
- Holloway, H. D. (1961) The Lower Cretaceous Trinity aquifers, McLennan County, Texas: Baylor Geol. Studies, Bull. 1, 32 pp.
- Leggat, E. R. (1957) Geology and ground-water resources of Tarrant County, Texas: Texas Board Water Engrs. Bull. 5709, 181 pp.
- Lozo, F. E. (1959) Stratigraphic relations of the Edwards Limestone and associated formations in North-central Texas: Univ. Texas Pub. 5905, pp. 1–20.
- \_\_\_\_\_, and Stricklin, F. L., Jr. (1956) Strati-

graphic notes on the outcrop basal Cretaceous, Central Texas: Gulf Coast Assoc. Geol. Soc., Trans., vol. 6, pp. 67-78.

Maxwell, R. A. (1962) Mineral resources of South Texas: Univ. Texas, Bur. Econ. Geology Rept. Invest. No. 43, 140 pp.

Moore, R. C. (1949) Rocks of Permian(?) age in the Colorado River valley, North-central Texas: U. S. Geol. Survey Oil and Gas Invest. Prelim. Map 80.

Murphy, T. D. (1960) Silica sand and pebbles, in Industrial minerals and rocks: Amer. Inst. Min. Met. Petrol. Engrs., 3d ed., pp. 763-772.

Plummer, F. B., and Moore, R. C. (1921) Stratigraphy of the Pennsylvanian formations of North-central Texas: Univ. Texas Bull. 2132, 237 pp.

Scott, Gayle, and Armstrong, J. M. (1932) The geology of Wise County, Texas: Univ. Texas

Bull. 3224, 77 pp.

Sidwell, Raymond (1947) Trinity sediments of North and Central Texas: Jour. Sed. Petrology, vol. 17, pp. 68-72.

Stafford, P. T. (1960) Geology of the Cross Plains quadrangle, Brown, Callahan, Coleman, and Eastland counties, Texas: U.S. Geol. Survey Bull. 1096-B, 72 pp.

Taff, J. A. (1892) Reports on the Cretaceous area north of the Colorado River: Texas Geol. Survey 3d Ann. Rept. (1891), pp. 267-379.

\_\_\_\_\_, and Leverett, S. (1893) Report on the Cretaceous area north of the Colorado River: Texas Geol. Survey 4th Ann. Rept. (1892), pt. 1, pp. 239-354.

U. S. Bureau of Mines (1964) Minerals Yearbook, Vol. I, Metals and minerals (except fuels): U. S. Bur. Mines, Washington, D. C.

## APPENDIX A

### Methodology

Field sampling and description. — Sand samples tested, analyzed, and reported in this publication were taken from readily accessible exposures, such as road cuts, pits, and stream or other natural exposures. Sampling was designed to give representative coverage of deposits in the area of Lower Cretaceous sand outcrop. In sampling from natural exposures, care was taken to remove weathered surface material and obtain a representative sample, but completely fresh sands could not be sampled at all exposures. Continuous channel samples were cut at approximately 5-foot intervals; in active pits, samples were taken from separate working or mining faces. Locality, description of sand units, thickness, overburden, and extent of deposit where discernible were recorded for all sites from which samples were taken. Field descriptions not included in this published report are at the Bureau of Economic Geology.

Laboratory preparation and analyses. — Sand samples were initially examined petrographically before washing to determine mineralogical composition, grain shape, and cohesion. Particle-size distribution and content of iron oxide were determined for samples consisting largely of sand-size particles and containing relatively small amounts of ferruginous materials. Percent of calcium oxide, magnesium oxide, alumina, and total heavy minerals was determined for selected low-iron sands.

Preparation of sand samples. — A 100-gram representative sample of the sand was mixed with water and a dispersing agent and plunged in a Hamilton Beach stirrer. The suspension was allowed to stand over night to check for complete dispersion of the clay fraction. After dispersion was complete the suspension was transferred to a cone hydro-classifier, set to remove particles smaller than 30 microns. The portion of the sample remaining in the container is expressed as the yield after coning (Appendix B); such yield is comparable to yields obtained in operational-size water classifiers. The sand was dried at 110° C and sieved through a 200-mesh screen. The +200-mesh fraction was weighed; a few grams were pulverized to -200 mesh for determination of iron oxide. The remainder was used in sieve analysis.

Heavy mineral analysis. — A washed and weighed, +200-mesh sample was placed in a glass separating funnel with a solution of tetrabromoethane (specific gravity, 2.96). Mineral grains with specific gravity greater than 2.96 were drawn from the funnel and washed in benzene; the sample

was dried initially in a steam bath and later in a hot-air bath. The dried portion was weighed and reported as a percent of the total weight of the sample.

Determination of iron oxide content. — Washed, dried 3-gram samples were ground uniformly to -200 mesh and packed uniformly in plastic trays. The prepared sample was bombarded in a fluorescent spectrophotometer equipped with a tungsten tube at 35 kv and 23 ma. The intensity of the iron peak was recorded, and content of iron expressed as an oxide determined by comparison of recorded values with those of known standards.

Determination of calcium oxide content. — Calcium oxide was determined by emission spectrography utilizing direct-current arc and a 1.5-meter ARL spectrograph. The Si 2568.64 Å line was used as an Internal Standard.

Determination of magnesium oxide content. — Magnesium oxide was determined spectrographically utilizing the same method as for calcium oxide.

Determination of alumina content. — Alumina content was determined spectrophotometrically from the residue after removing the silica as silicon tetrafluoride. Spectrophotometric determination involved measuring the absorption of light at 475 millimicrons of a solution in which aluminum has been converted to calcium aluminum alizarin red-S complex.

Sieve analysis. — Sand samples were quartered and a 100-gram sample taken from one quarter for analysis. Sample was placed in a Rotap shaker and agitated for 20 minutes. Fractions taken from each screen and from the pan were weighed and reported as a percent of the total weight.

Determination of statistical values. — Graphic mean grain size of the +200-sand fraction was determined by reading three points from a cumulative curve plotted with frequency as the ordinate and grain size (in phi units) as the abscissa. These points were utilized in the following equation of Folk (1961, p. 44) to determine mean grain size:  $M_z = (\phi_{16} + \phi_{50} + \phi_{84})/3$ . Values reported in Results of Tests (Appendix B) are given in both phi units and mm. Equivalence of values in the statistical analyses of sand samples is as follows:

| <u>U. S. Standard<br/>Sieve Mesh Number</u> | <u>Millimeters</u> | <u>Phi (<math>\phi</math>)</u> |
|---------------------------------------------|--------------------|--------------------------------|
| 10                                          | 2.00               | -1.0                           |
| 12                                          | 1.68               | -0.75                          |
| 14                                          | 1.41               | -0.5                           |
| 16                                          | 1.19               | -0.25                          |
| 18                                          | 1.00               | 0.0                            |
| 20                                          | 0.84               | 0.25                           |
| 25                                          | 0.71               | 0.5                            |
| 30                                          | 0.59               | 0.75                           |
| 35                                          | 0.50               | 1.0                            |
| 40                                          | 0.42               | 1.25                           |
| 45                                          | 0.35               | 1.5                            |
| 50                                          | 0.30               | 1.75                           |
| 60                                          | 0.25               | 2.0                            |
| 70                                          | 0.21               | 2.25                           |
| 80                                          | 0.177              | 2.5                            |
| 100                                         | 0.149              | 2.75                           |
| 120                                         | 0.125              | 3.0                            |
| 140                                         | 0.105              | 3.25                           |
| 170                                         | 0.088              | 3.5                            |
| 200                                         | 0.074              | 3.75                           |
| 230                                         | 0.062              | 4.0                            |
| 270                                         | 0.053              | 4.25                           |
| 325                                         | 0.044              | 4.5                            |

Sorting index reported in Appendix B and elsewhere in this report was determined from the +200-mesh fraction using the Inclusive Graphic Standard Deviation ( $\sigma$ ) of Folk (1961, p. 45):

$$\sigma = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$$

Values are reported in phi units, classified as follows:

| <u><math>\sigma</math> values</u> | <u>Descriptive category</u> |
|-----------------------------------|-----------------------------|
| less than 0.35 $\phi$             | very well sorted            |
| 0.35 to 0.50 $\phi$               | well sorted                 |
| 0.50 to 0.71 $\phi$               | moderately well sorted      |
| 0.71 to 1.0 $\phi$                | moderately sorted           |
| 1.0 to 2.0 $\phi$                 | poorly sorted               |
| 2.0 to 4.0 $\phi$                 | very poorly sorted          |
| more than 4.0 $\phi$              | extremely poorly sorted     |

APPENDIX BResults of Tests

Physical and chemical analyses are reported for approximately 175 samples of Lower Cretaceous sands from 114 localities in 17 counties of North-central, North, and West Texas. Yield after coning, graphic mean, sorting index, particle-size distribution, and content of iron oxide are given for each sample. Content of heavy minerals, magnesium oxide, calcium oxide, and alumina is reported for selected low-iron sands. Particle-size distribution is given by percent total weight of individual fractions retained on specified screens and reported for individual mesh fractions as well as cumulatively for both the original unwashed sample and the washed +200-mesh sample.

Specific localities are identified by county name and locality number (e.g., Callahan County 1). Specific sample intervals from individual localities are indicated by number appended to the locality number and by Mineral Studies Laboratory Number [e.g., Callahan 1-1 (64139)]. Sample localities are indicated on an index map given with a brief locality description; localities are also indicated on a geologic base map (Pl. I). Stratigraphic unit is designated for each locality. Data are reported alphabetically by county and numerically within each county.

LOCATION.

BOSQUE COUNTY 1. Stream exposure along gravel road, 6 miles east of Iredell. Paluxy Formation.

Sample number.-- Bosque 1-1 (64135)

Yield after coning.-- 97.6%

Shape of grains.-- Subangular

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.31 $\phi$  (very well sorted)

Heavy mineral content.-- N.D.\*

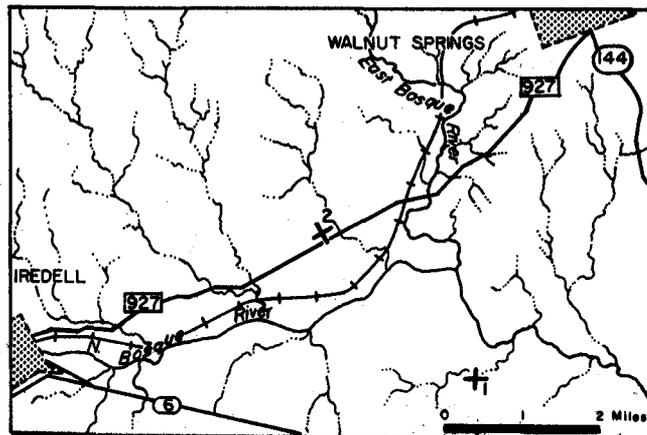
Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

\*N.D. = Not determined



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.2            | 0.3                | 0.3            | 0.4                |
| - 80+100                   | 2.4            | 2.7                | 2.9            | 3.3                |
| - 100+140                  | 26.6           | 29.3               | 31.8           | 35.1               |
| - 140+200                  | 54.0           | 83.3               | 65.0           | 100.1              |
| - 200+ pan                 | 16.8           | 100.1              |                |                    |

Sample number.-- Bosque 1-2 (64136)

Yield after coning.-- 98.0%

Shape of grains.-- Subangular

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.31 $\phi$  (very well sorted)

Heavy mineral content.-- 0.093%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.3            | 0.4                | 0.4            | 0.5                |
| - 80+100                   | 3.2            | 3.6                | 4.0            | 4.5                |
| - 100+140                  | 24.3           | 27.9               | 30.6           | 35.1               |
| - 140+200                  | 51.6           | 79.5               | 65.0           | 100.1              |
| - 200+ pan                 | 20.5           | 100.0              |                |                    |

Sample number.-- Bosque 1-3 (64137)

Yield after coning.-- 98.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.30\phi$  (very well sorted)

Heavy mineral content.-- 0.095%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 40+60                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 60+80                          | 0.4               | 0.5                   | 0.5               | 0.6                   |
| - 80+100                         | 3.9               | 4.4                   | 4.6               | 5.2                   |
| - 100+140                        | 30.0              | 34.4                  | 35.1              | 40.3                  |
| - 140+200                        | 51.0              | 85.4                  | 59.7              | 100.0                 |
| - 200+ pan                       | 14.6              | 100.0                 |                   |                       |

Sample number.-- Bosque 1-4 (64138)

Yield after coning.-- 97.0%

Shape of grains.-- Subangular

Graphic mean.--  $3.1\phi$  (0.10 mm)

Sorting index.--  $0.32\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 71.0%

Magnesium oxide content.-- N.D.

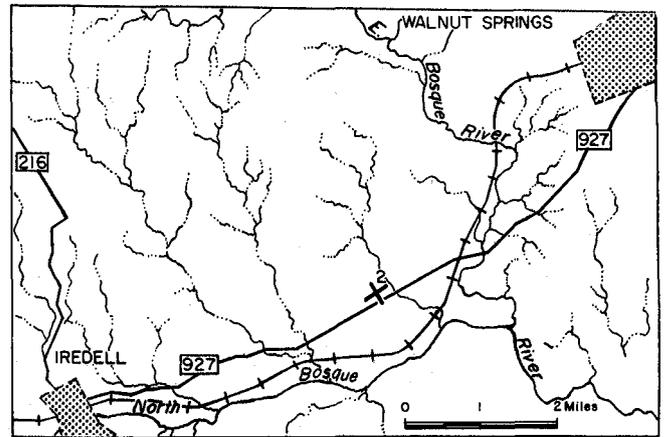
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.2               | 0.2                   | 0.3               | 0.3                   |
| - 20+40                          | 0.2               | 0.4                   | 0.2               | 0.5                   |
| - 40+60                          | 0.2               | 0.6                   | 0.3               | 0.8                   |
| - 60+80                          | 0.3               | 0.9                   | 0.4               | 1.2                   |
| - 80+100                         | 2.9               | 3.8                   | 3.6               | 4.8                   |
| - 100+140                        | 27.0              | 30.8                  | 33.6              | 38.4                  |
| - 140+200                        | 49.6              | 80.4                  | 61.6              | 100.0                 |
| - 200+ pan                       | 19.6              | 100.4                 |                   |                       |

LOCATION.

BOSQUE COUNTY 2. Road cut, north side of Farm Road 927, 4.0 miles east of Iredell. Paluxy Formation.



Sample number.-- Bosque 2-1 (64133)

Yield after coning.-- 96.5%

Shape of grains.-- Subrounded

Graphic mean.--  $3.3\phi$  (0.10 mm)

Sorting index.--  $0.27\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.17%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.6            | 0.6                | 1.3            | 1.3                |
| - 20+40                    | 0.0            | 0.6                | 0.1            | 1.4                |
| - 40+60                    | 0.0            | 0.6                | 0.1            | 1.5                |
| - 60+80                    | 0.1            | 0.7                | 0.2            | 1.7                |
| - 80+100                   | 1.2            | 1.9                | 2.6            | 4.3                |
| - 100+140                  | 5.8            | 7.7                | 12.6           | 16.9               |
| - 140+200                  | 38.2           | 45.9               | 83.0           | 99.9               |
| - 200+ pan                 | 54.0           | 99.9               |                |                    |

Sample number.-- Bosque 2-2 (64134)

Yield after coning.-- 97.3%

Shape of grains.-- Subrounded

Graphic mean.--  $3.3\phi$  (0.10 mm)

Sorting index.--  $0.27\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 70.5%

Magnesium oxide content.-- N.D.

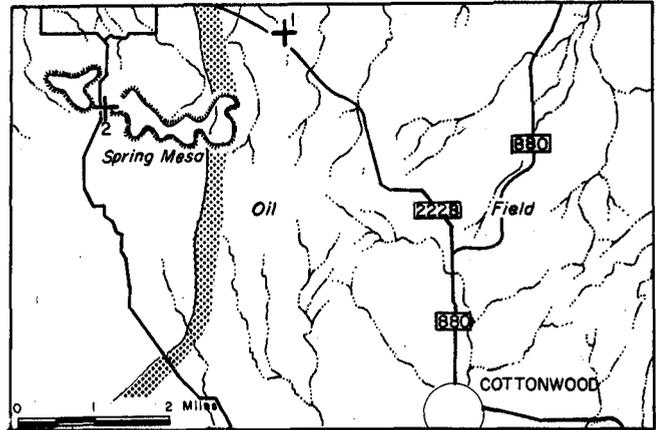
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.3            | 0.3                | 0.5            | 0.5                |
| - 20+40                    | 0.4            | 0.7                | 0.6            | 1.1                |
| - 40+60                    | 0.3            | 1.0                | 0.5            | 1.6                |
| - 60+80                    | 0.2            | 1.2                | 0.4            | 2.0                |
| - 80+100                   | 0.6            | 1.8                | 1.0            | 3.0                |
| - 100+140                  | 8.2            | 10.0               | 13.9           | 16.9               |
| - 140+200                  | 48.9           | 58.9               | 83.0           | 99.9               |
| - 200+ pan                 | 41.0           | 99.9               |                |                    |

## LOCATION.

CALLAHAN COUNTY 1. Gully, north side of Farm Road 2228, 7.0 miles southwest of Putnam. Antlers Formation (lower unit).



Sample number.-- Callahan 1-1 (64139)

Yield after coning.-- 94.7%

Shape of grains.-- Subrounded

Graphic mean.--  $2.0\phi$  (0.25 mm)

Sorting index.--  $0.42\phi$  (well sorted)

Heavy mineral content.-- 0.017%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.8            | 0.8                | 0.8            | 0.8                |
| - 40+60                    | 14.2           | 15.0               | 15.0           | 15.8               |
| - 60+80                    | 45.2           | 60.2               | 47.7           | 63.5               |
| - 80+100                   | 26.4           | 86.6               | 27.9           | 91.4               |
| - 100+140                  | 7.1            | 93.7               | 7.5            | 98.9               |
| - 140+200                  | 1.0            | 94.7               | 1.1            | 100.0              |
| - 200+ pan                 | 5.3            | 100.0              |                |                    |

Sample number.-- Callahan 1-2 (64140)

Yield after coning.-- 77.4%

Shape of grains.-- Rounded

Graphic mean.--  $2.1\phi$  (0.23 mm)

Sorting index.--  $0.45\phi$  (well sorted)

Heavy mineral content.-- 0.042%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.02%

Calcium oxide content.-- 0.01%

Alumina content.-- 0.78%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.5            | 0.5                | 0.6            | 0.6                |
| - 40+60                    | 9.5            | 10.0               | 12.4           | 13.0               |
| - 60+80                    | 26.0           | 36.0               | 33.9           | 46.9               |
| - 80+100                   | 26.6           | 62.6               | 34.7           | 81.6               |
| - 100+140                  | 12.4           | 75.0               | 16.2           | 97.8               |
| - 140+200                  | 1.7            | 76.7               | 2.2            | 100.0              |
| - 200+ pan                 | 23.2           | 99.9               |                |                    |

Sample number.-- Callahan 1-3 (64144)

Yield after coning.-- N.D.

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 1.8 $\phi$  (0.29 mm)

Sorting index.-- 0.43 $\phi$  (well sorted)

Heavy mineral content.-- 0.029%

Iron oxide content.-- 0.03%

Magnesium oxide content.-- 0.02%

Calcium oxide content.-- 0.03%

Alumina content.-- 0.74%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 1.6            | 1.7                | 1.7            | 1.8                |
| - 40+60                    | 23.8           | 25.5               | 25.1           | 26.9               |
| - 60+80                    | 43.0           | 68.5               | 45.3           | 72.2               |
| - 80+100                   | 21.0           | 89.5               | 22.1           | 94.3               |
| - 100+140                  | 5.0            | 94.5               | 5.3            | 99.6               |
| - 140+200                  | 0.4            | 94.9               | 0.4            | 100.0              |
| - 200+ pan                 | 5.0            | 99.9               |                |                    |

Sample number.-- Callahan 1-4 (64142)

Yield after coning.-- 97.7%

Shape of grains.-- Rounded

Graphic mean.-- 1.6 $\phi$  (0.34 mm)

Sorting index.-- 0.47 $\phi$  (well sorted)

Heavy mineral content.-- 0.013%

Iron oxide content.-- 0.025%

Magnesium oxide content.-- 0.06%

Calcium oxide content.-- 0.02%

Alumina content.-- 0.56%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.7            | 0.7                | 0.7            | 0.7                |
| - 40+60                    | 46.9           | 47.6               | 48.1           | 48.8               |
| - 60+80                    | 43.8           | 91.4               | 44.9           | 93.7               |
| - 80+100                   | 5.0            | 96.4               | 5.1            | 98.8               |
| - 100+140                  | 1.0            | 97.4               | 1.0            | 99.8               |
| - 140+200                  | 0.1            | 97.5               | 0.1            | 99.9               |
| - 200+ pan                 | 2.5            | 100.0              |                |                    |

Sample number.-- Callahan 1-5 (64143)

Yield after coning.-- 91.7%

Shape of grains.-- Subrounded to well rounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.026%

Iron oxide content.-- 0.045%

Magnesium oxide content.-- 0.01%

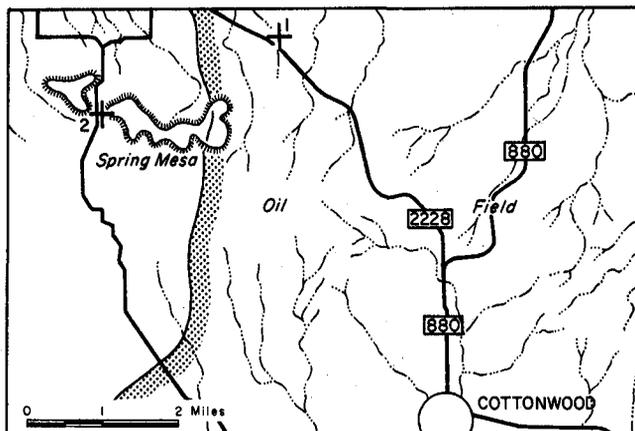
Calcium oxide content.-- 0.02%

Alumina content.-- 0.87%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.5            | 0.5                | 0.6            | 0.6                |
| - 40+60                    | 13.2           | 13.7               | 14.7           | 15.3               |
| - 60+80                    | 40.3           | 54.0               | 44.7           | 60.0               |
| - 80+100                   | 25.5           | 79.5               | 28.3           | 88.3               |
| - 100+140                  | 8.7            | 88.2               | 9.7            | 98.0               |
| - 140+200                  | 1.7            | 89.9               | 1.9            | 99.9               |
| - 200+ pan                 | 9.9            | 99.8               |                |                    |

## LOCATION.

CALLAHAN COUNTY 2. Outcrop, west end of Spring Mesa, east side of secondary road, 9.0 miles southwest of Putnam. Antlers Formation (upper unit).



Sample number.-- Callahan 2 (64144)

Yield after coning.--95.6%

Shape of grains.-- Subangular

Graphic mean.--  $2.6\phi$  (0.17 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- 0.038%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.02%

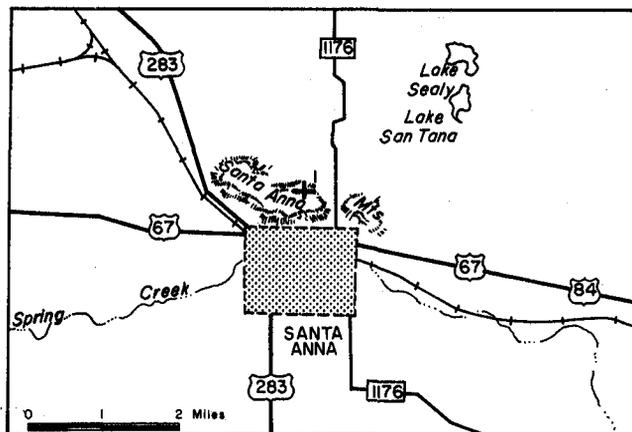
Calcium oxide content.-- 0.03%

Alumina content.-- 1.09%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.6            | 0.6                | 0.6            | 0.6                |
| - 60+80                    | 12.0           | 1.6                | 12.7           | 13.3               |
| - 80+100                   | 33.7           | 46.3               | 35.6           | 48.9               |
| - 100+140                  | 39.1           | 85.4               | 41.3           | 90.2               |
| - 140+200                  | 9.2            | 94.6               | 9.7            | 99.9               |
| - 200+ pan                 | 5.3            | 99.9               |                |                    |

## LOCATION.

COLEMAN COUNTY 1. Northeast face of inactive quarry (Santa Anna Silica Sand Company), at Santa Anna. Antlers Formation (upper unit).



Sample number.-- Coleman 1-1 (64145)

Yield after coning.--99.5%

Shape of grains.-- Subangular to well rounded

Graphic mean.--  $2.2\phi$  (0.22 mm)

Sorting index.--  $0.4\phi$  (well sorted)

Heavy mineral content.-- 0.003%

Iron oxide content.-- 0.03%

Magnesium oxide content.-- 0.02%

Calcium oxide content.-- 0.14%

Alumina content.-- 0.50%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.8            | 0.9                | 0.8            | 0.9                |
| - 40+60                    | 9.6            | 10.5               | 9.7            | 10.6               |
| - 60+80                    | 29.5           | 40.0               | 29.7           | 40.3               |
| - 80+100                   | 47.1           | 87.1               | 47.5           | 87.8               |
| - 100+140                  | 9.7            | 96.8               | 9.8            | 97.6               |
| - 140+200                  | 2.4            | 99.2               | 2.4            | 100.0              |
| - 200+ pan                 | 0.7            | 99.9               |                |                    |

Sample number.-- Coleman 1-2 (64146)

Yield after coning.-- 97.0%

Shape of grains.-- Subangular to well rounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.022%

Iron oxide content.-- 0.02%

Magnesium oxide content.-- 0.02%

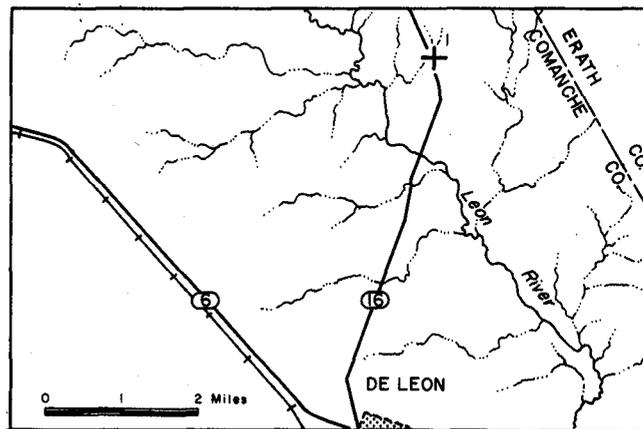
Calcium oxide content.-- 0.01%

Alumina content.-- 0.49%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.8            | 0.8                | 0.8            | 0.8                |
| - 40+60                    | 16.0           | 16.8               | 16.5           | 17.3               |
| - 60+80                    | 24.0           | 40.8               | 24.7           | 42.0               |
| - 80+100                   | 45.7           | 86.5               | 47.1           | 89.1               |
| - 100+140                  | 10.0           | 96.5               | 10.3           | 99.4               |
| - 140+200                  | 0.5            | 97.0               | 0.5            | 99.9               |
| - 200+ pan                 | 3.0            | 100.0              |                |                    |

LOCATION.

COMANCHE COUNTY 1. Road cut, east side of State Highway 16, 5.5 miles north of DeLeon. Twin Mountains Formation (lower unit).



Sample number.-- Comanche 1 (64147)

Yield after coning.-- 94.2%

Shape of grains.-- Subangular

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.20%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 1.4            | 1.5                | 1.5            | 1.6                |
| - 40+60                    | 13.0           | 14.5               | 14.0           | 15.6               |
| - 60+80                    | 38.6           | 53.1               | 41.4           | 57.0               |
| - 80+100                   | 29.3           | 82.4               | 31.4           | 88.4               |
| - 100+140                  | 9.1            | 91.5               | 9.7            | 98.1               |
| - 140+200                  | 1.8            | 93.3               | 1.9            | 100.0              |
| - 200+ pan                 | 6.6            | 99.9               |                |                    |

## LOCATION.

COMANCHE COUNTY 2. Road cut, west side of State Highway 6, 1.8 miles south-east of DeLeon. Twin Mountains Formation (lower unit).

Sample number.-- Comanche 2 (64148)

Yield after coning.-- 85.4%

Shape of grains.-- Subangular

Graphic mean.--  $1.6\phi$  (0.33 mm)

Sorting index.--  $0.8\phi$  (moderately sorted)

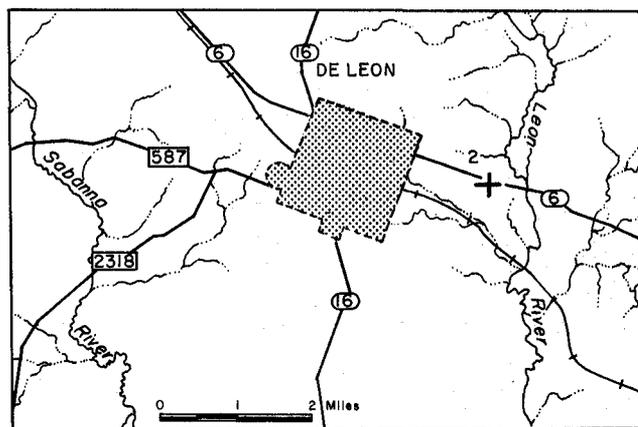
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.17%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.8            | 0.8                | 1.0            | 1.0                |
| - 20+40                    | 7.7            | 8.5                | 9.2            | 10.2               |
| - 40+60                    | 39.0           | 47.5               | 46.4           | 56.6               |
| - 60+80                    | 21.1           | 68.6               | 25.1           | 81.7               |
| - 80+100                   | 11.0           | 79.6               | 13.1           | 94.8               |
| - 100+140                  | 3.6            | 83.2               | 4.3            | 99.1               |
| - 140+200                  | 0.8            | 84.0               | 1.0            | 100.1              |
| - 200+ pan                 | 15.9           | 99.9               |                |                    |

## LOCATION.

COMANCHE COUNTY 3. Road cut on gravel road to abandoned limestone quarry east of north-south secondary road, 7.5 miles west of Comanche. Paluxy Formation.

Sample number.-- Comanche 3 (64152)

Yield after coning.-- 84.8%

Shape of grains.-- Subrounded

Graphic mean.--  $2.7\phi$  (0.15 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

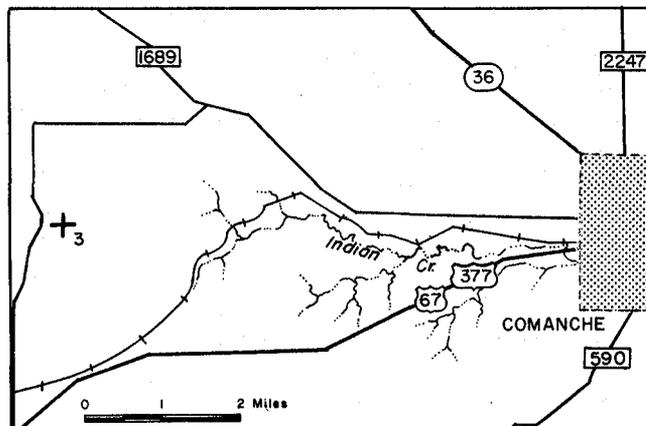
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

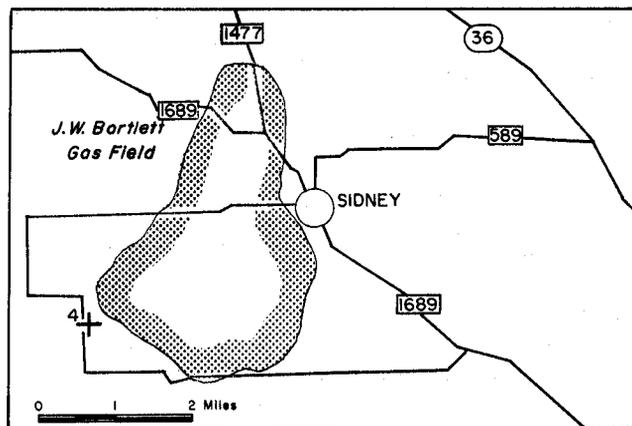
Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.3            | 0.3                | 0.4            | 0.4                |
| - 60+80                    | 6.0            | 6.3                | 8.0            | 8.4                |
| - 80+100                   | 23.1           | 29.4               | 30.8           | 39.2               |
| - 100+140                  | 32.2           | 61.6               | 43.0           | 82.2               |
| - 140+200                  | 13.4           | 75.0               | 17.8           | 100.0              |
| - 200+ pan                 | 25.0           | 100.0              |                |                    |

LOCATION.

COMANCHE COUNTY 4. Stream cut, south bank of branch of Sweetwater Creek, north side of secondary road, 11 miles northwest of Comanche. Twin Mountains Formation (upper unit).



Sample number.-- Comanche 4-1 (64149)

Yield after coning.-- 92.3%

Shape of grains.-- Subrounded

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.051%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 5.3            | 5.4                | 6.0            | 6.1                |
| - 60+80                    | 21.5           | 26.9               | 24.4           | 30.5               |
| - 80+100                   | 26.2           | 53.1               | 29.6           | 60.1               |
| - 100+140                  | 25.0           | 78.1               | 28.3           | 88.4               |
| - 140+200                  | 10.2           | 88.3               | 11.5           | 99.9               |
| - 200+ pan                 | 11.8           | 100.1              |                |                    |

Sample number.-- Comanche 4-2 (64150)

Yield after coning.-- N.D.

Shape of grains.-- Subangular

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- 0.045%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 4.0            | 4.0                | 4.7            | 4.7                |
| - 60+80                    | 12.1           | 16.1               | 14.1           | 18.8               |
| - 80+100                   | 31.5           | 47.6               | 36.7           | 55.5               |
| - 100+140                  | 26.1           | 73.7               | 30.4           | 85.9               |
| - 140+200                  | 12.1           | 85.8               | 14.1           | 100.0              |
| - 200+ pan                 | 14.1           | 99.9               |                |                    |

Sample number.--Comanche 4-3 (64151)

Yield after coning.-- 90.4%

Shape of grains.-- Subangular

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N.D.

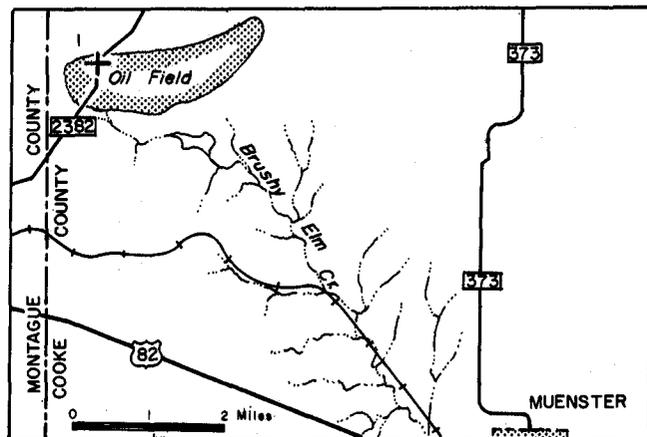
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 40+60                          | 15.7              | 15.8                  | 18.5              | 18.6                  |
| - 60+80                          | 28.2              | 44.0                  | 33.2              | 52.8                  |
| - 80+100                         | 23.8              | 67.8                  | 28.0              | 80.8                  |
| - 100+140                        | 13.0              | 80.8                  | 15.3              | 96.1                  |
| - 140+200                        | 4.1               | 84.9                  | 4.8               | 99.9                  |
| - 200+ pan                       | 15.2              | 100.1                 |                   |                       |

#### LOCATION.

COOKE COUNTY 1. Road cut along Farm Road 2382, 4.5 miles northeast of Saint Jo. Antlers Formation.



Sample number.-- Cooke 1 (64159)

Yield after coning.-- 94.3%

Shape of grains.-- Rounded to well rounded

Graphic mean.-- 2.0 $\phi$  (0.25 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.041%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 20+40                          | 1.5               | 1.6                   | 1.6               | 1.7                   |
| - 40+60                          | 27.8              | 29.4                  | 29.8              | 31.5                  |
| - 60+80                          | 35.1              | 64.5                  | 37.6              | 69.1                  |
| - 80+100                         | 15.4              | 79.9                  | 16.5              | 85.6                  |
| - 100+140                        | 10.4              | 90.3                  | 11.1              | 96.7                  |
| - 140+200                        | 3.0               | 93.3                  | 3.2               | 99.9                  |
| - 200+ pan                       | 6.6               | 99.9                  |                   |                       |

LOCATION.

COOKE COUNTY 1A. Road cut along Farm Road 2382, 4.5 miles northeast of Saint Jo; 75 yards north of locality 1. Antlers Formation.

Sample number.--Cooke 1A (64160)

Yield after coning.--93.5%

Shape of grains.-- Subangular to well rounded

Graphic mean.--2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.079%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 40+60                    | 3.3            | 3.5                | 4.1            | 4.3                |
| - 60+80                    | 6.3            | 9.8                | 7.9            | 12.2               |
| - 80+100                   | 16.3           | 26.1               | 20.5           | 32.7               |
| - 100+140                  | 26.9           | 53.0               | 33.8           | 66.5               |
| - 140+200                  | 26.5           | 79.5               | 33.3           | 99.8               |
| - 200+ pan                 | 20.4           | 99.9               |                |                    |

LOCATION.

COOKE COUNTY 2. Road cut along Farm Road 373, 9.5 miles north of Muenster. Antlers Formation.

Sample number.-- Cooke 2 (64158)

Yield after coning.--88.3%

Shape of grains.-- Rounded to subrounded

Graphic mean.--2.7 $\phi$  (0.15 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

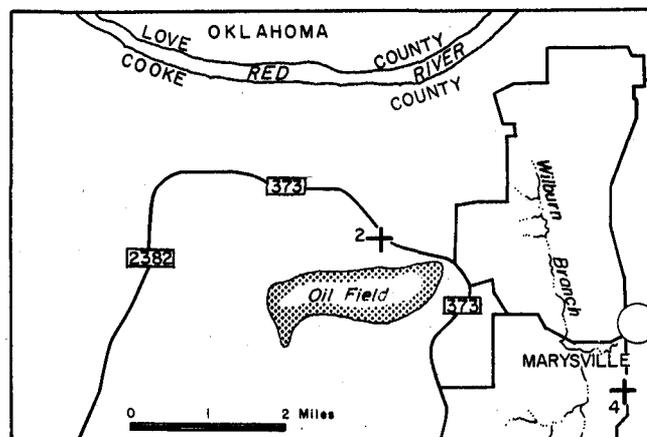
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

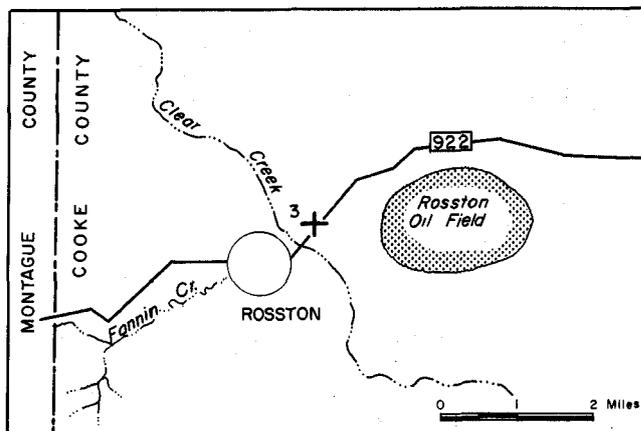
Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 2.6            | 2.6                | 4.1            | 4.1                |
| - 20+40                    | 0.1            | 2.7                | 0.1            | 4.2                |
| - 40+60                    | 0.3            | 3.0                | 0.5            | 4.7                |
| - 60+80                    | 2.4            | 5.4                | 3.8            | 8.5                |
| - 80+100                   | 10.5           | 15.9               | 16.6           | 25.1               |
| - 100+140                  | 20.8           | 36.7               | 33.0           | 58.1               |
| - 140+200                  | 26.1           | 62.8               | 41.4           | 99.5               |
| - 200+ pan                 | 36.8           | 99.6               |                |                    |

## LOCATION.

COOKE COUNTY 3. Road cut, north side of Farm Road 922, 0.6 mile east of Clear Creek crossing. Antlers Formation.



Sample number.--Cooke 3-1 (64153)

Yield after coning.--96.1%

Shape of grains.-- Subangular to rounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.25\phi$  (very well sorted)

Heavy mineral content.-- 0.021%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 0.2            | 0.3                | 0.2            | 0.2                |
| - 60+80                    | 4.0            | 4.3                | 4.3            | 4.5                |
| - 80+100                   | 30.4           | 34.7               | 32.6           | 37.1               |
| - 100+140                  | 43.8           | 88.5               | 47.0           | 84.1               |
| - 140+200                  | 14.7           | 93.2               | 15.8           | 99.9               |
| - 200+ pan                 | 6.7            | 99.9               |                |                    |

Sample number.-- Cooke 3-2 (64154)

Yield after coning.-- 72.7%

Shape of grains.-- Rounded

Graphic mean.--  $3.1\phi$  (0.12mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.11%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.2            | 0.2                | 0.4            | 0.4                |
| - 60+80                    | 0.5            | 0.7                | 1.0            | 1.4                |
| - 80+100                   | 1.4            | 2.1                | 2.7            | 4.1                |
| - 100+140                  | 13.4           | 15.5               | 25.2           | 29.3               |
| - 140+200                  | 37.6           | 53.1               | 70.7           | 100.0              |
| - 200+ pan                 | 46.9           | 100.0              |                |                    |

Sample number.--Cooke 3-3 (64155)

Yield after coning.--79.1%

Shape of grains.--Rounded to well rounded

Graphic mean.--2.5 $\phi$  (0.18 mm)

Sorting index.--0.6 $\phi$  (moderately well sorted)

Heavy mineral content.--N.D.

Iron oxide content.--0.05%

Magnesium oxide content.--N.D.

Calcium oxide content.--N.D.

Alumina content.--N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| -10+20                           | 0.3               | 0.3                   | 0.4               | 0.4                   |
| -20+40                           | 1.1               | 1.4                   | 1.6               | 2.0                   |
| -40+60                           | 6.3               | 7.7                   | 9.5               | 11.5                  |
| -60+80                           | 9.0               | 16.7                  | 13.5              | 25.0                  |
| -80+100                          | 11.2              | 27.9                  | 16.7              | 41.7                  |
| -100+140                         | 20.8              | 48.7                  | 31.2              | 72.9                  |
| -140+200                         | 18.6              | 67.3                  | 27.8              | 100.7                 |
| -200+ pan                        | 33.1              | 100.4                 |                   |                       |

Sample number.--Cooke 3-4 (64156)

Yield after coning.--89.6%

Shape of grains.--Rounded to well rounded

Graphic mean.--2.4 $\phi$  (0.19 mm)

Sorting index.--0.8 $\phi$  (moderately well sorted)

Heavy mineral content.--0.031%

Iron oxide content.--0.04%

Magnesium oxide content.--0.04%

Calcium oxide content.--0.02%

Alumina content.--0.56%

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| -10+20                           | 0.2               | 0.2                   | 0.3               | 0.3                   |
| -20+40                           | 1.4               | 1.6                   | 1.8               | 2.1                   |
| -40+60                           | 11.6              | 13.2                  | 14.4              | 16.5                  |
| -60+80                           | 16.9              | 30.1                  | 21.1              | 37.6                  |
| -80+100                          | 13.7              | 43.8                  | 17.1              | 54.7                  |
| -100+140                         | 19.1              | 62.9                  | 23.8              | 78.5                  |
| -140+200                         | 17.1              | 80.0                  | 21.3              | 99.8                  |
| -200+ pan                        | 19.8              | 99.8                  |                   |                       |

Sample number.--Cooke 3-5 (64157)

Yield after coning.--93.9%

Shape of grains.--Subrounded to rounded

Graphic mean.--2.1 $\phi$  (0.24 mm)

Sorting index.--0.36 $\phi$  (well sorted)

Heavy mineral content.--0.012%

Iron oxide content.--0.04%

Magnesium oxide content.--0.04%

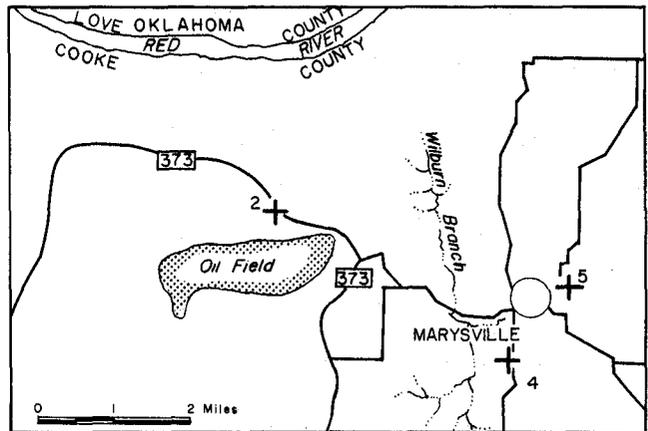
Calcium oxide content.--0.02%

Alumina content.--0.73%

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| -10+20                           | 0.0               | 0.0                   | 0.0               | 0.0                   |
| -20+40                           | 0.1               | 0.1                   | 0.1               | 0.1                   |
| -40+60                           | 8.0               | 8.1                   | 8.6               | 8.7                   |
| -60+80                           | 37.5              | 45.6                  | 40.1              | 48.8                  |
| -80+100                          | 40.1              | 85.7                  | 42.9              | 91.7                  |
| -100+140                         | 7.3               | 93.0                  | 7.8               | 99.5                  |
| -140+200                         | 0.4               | 93.4                  | 0.4               | 99.9                  |
| -200+ pan                        | 6.4               | 99.8                  |                   |                       |

LOCATION.

COOKE COUNTY 4. Road cut along gravel road, 1.0 mile south of Marysville. Antlers Formation.



Sample number.-- Cooke 4 (64161)

Yield after coning.-- 90.1%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.7 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.030%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

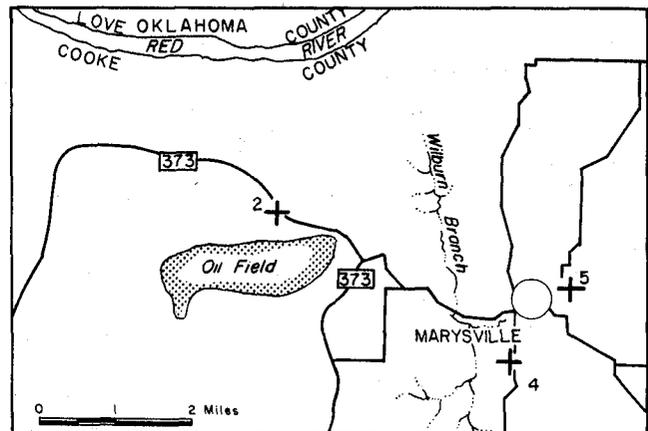
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.4            | 0.5                | 0.5            | 0.6                |
| - 40+60                    | 10.3           | 10.8               | 12.8           | 13.4               |
| - 60+80                    | 22.1           | 32.9               | 27.6           | 41.0               |
| - 80+100                   | 18.9           | 51.8               | 23.6           | 64.6               |
| - 100+140                  | 14.6           | 66.4               | 18.2           | 82.8               |
| - 140+200                  | 13.8           | 80.2               | 17.2           | 100.0              |
| - 200+ pan                 | 19.8           | 100.0              |                |                    |

LOCATION.

COOKE COUNTY 5. Road cut along gravel road, 0.8 mile east of Marysville. Antlers Formation.



Sample number.-- Cooke 5 (64162)

Yield after coning.-- 89.4%

Shape of grains.-- Rounded

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.14%

Magnesium oxide content.-- N.D.

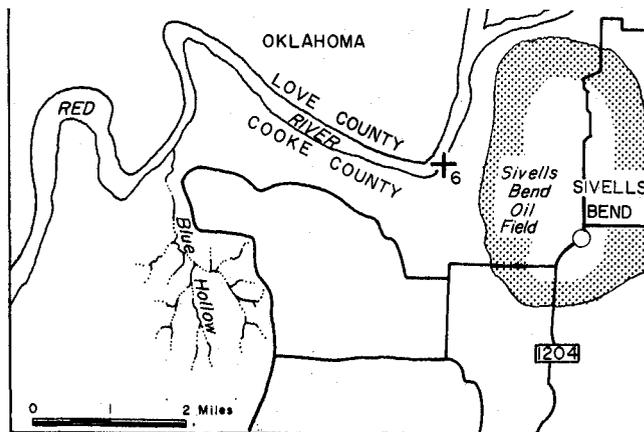
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.3            | 0.3                |
| - 40+60                    | 2.2            | 2.4                | 3.4            | 3.7                |
| - 60+80                    | 1.7            | 4.1                | 2.7            | 6.4                |
| - 80+100                   | 1.6            | 5.7                | 2.5            | 8.9                |
| - 100+140                  | 11.5           | 17.2               | 18.1           | 27.0               |
| - 140+200                  | 46.6           | 63.8               | 73.3           | 100.3              |
| - 200+ pan                 | 36.3           | 100.1              |                |                    |

LOCATION.

COOKE COUNTY 6. Bluff along south side of Red River, near pipeline crossing, 2.0 miles northwest of Sivells Bend. Antlers Formation.



Sample number.--Cooke 6 (64163)

Yield after coning.-- 93.0%

Shape of grains.-- Subrounded

Graphic mean.-- 2.2 $\phi$  (0.22 mm)

Sorting index.-- 0.7 $\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

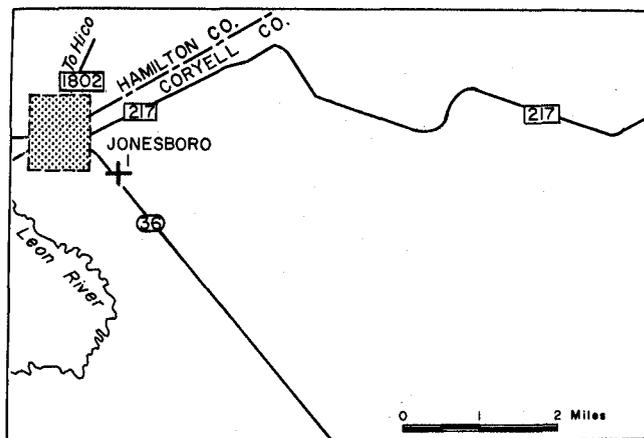
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 2.8            | 2.8                | 3.1            | 3.1                |
| - 20+40                    | 2.1            | 4.9                | 2.4            | 5.5                |
| - 40+60                    | 11.4           | 16.3               | 12.8           | 18.3               |
| - 60+80                    | 17.5           | 33.8               | 19.6           | 37.9               |
| - 80+100                   | 21.6           | 55.4               | 24.2           | 62.1               |
| - 100+140                  | 24.9           | 80.3               | 28.0           | 90.1               |
| - 140+200                  | 8.7            | 89.0               | 9.8            | 99.9               |
| - 200+ pan                 | 10.8           | 99.8               |                |                    |

LOCATION.

CORYELL COUNTY 1. Road cut along State Highway 36, 0.8 mile southeast of Jonesboro. Paluxy Formation.



Sample number.--Coryell 1 (64164)

Yield after coning.-- 96.0%

Shape of grains.-- Rounded

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.15%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.3            | 0.3                | 0.4            | 0.4                |
| - 20+40                    | 0.1            | 0.4                | 0.1            | 0.5                |
| - 40+60                    | 0.3            | 0.7                | 0.4            | 0.9                |
| - 60+80                    | 0.7            | 1.4                | 1.0            | 1.9                |
| - 80+100                   | 3.2            | 4.6                | 4.4            | 6.3                |
| - 100+140                  | 17.6           | 22.2               | 24.4           | 30.7               |
| - 140+200                  | 50.0           | 72.2               | 69.2           | 99.9               |
| - 200+ pan                 | 27.7           | 99.9               |                |                    |

## LOCATION.

DENTON COUNTY 1. Road cut, north side of Farm Road 51, 10.0 miles northwest of Sanger at Clear Creek crossing. Antlers Formation.

Sample number.--Denton 1. (64165)

Yield after coning.-- 89.7%

Shape of grains.-- Rounded

Graphic mean.--  $2.2\phi$  (0.22 mm)

Sorting index.--  $0.6\phi$  (moderately well sorted)

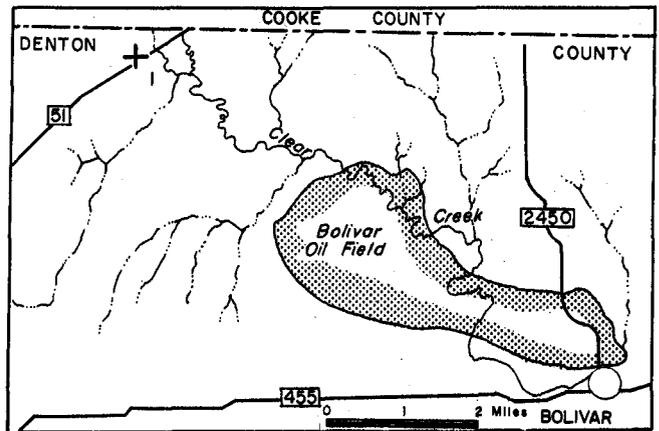
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.16%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 8.7            | 8.7                | 13.0           | 13.0               |
| - 20+40                    | 1.1            | 9.8                | 1.6            | 14.6               |
| - 40+60                    | 4.1            | 13.9               | 6.1            | 20.7               |
| - 60+80                    | 2.9            | 16.8               | 4.3            | 25.0               |
| - 80+100                   | 5.7            | 22.5               | 8.6            | 33.6               |
| - 100+140                  | 19.1           | 41.6               | 28.6           | 62.2               |
| - 140+200                  | 23.9           | 65.5               | 36.8           | 99.0               |
| - 200+ pan                 | 33.2           | 98.7               |                |                    |

## LOCATION.

ERATH COUNTY 1. Road cut, north side of U.S. Highway 377, 0.5 mile west of South Paluxy River, 6 miles southwest of Bluffdale. Twin Mountains Formation (upper unit).

Sample number.-- Erath 1 (64166)

Yield after coning.-- 97.7%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $2.5\phi$  (0.18 mm)

Sorting index.--  $0.4\phi$  (well sorted)

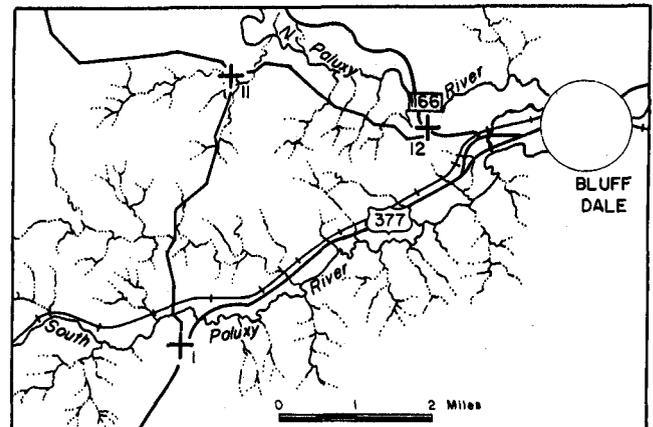
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.5            | 0.5                | 0.6            | 0.6                |
| - 60+80                    | 18.5           | 19.0               | 20.4           | 21.0               |
| - 80+100                   | 37.8           | 56.8               | 41.6           | 62.6               |
| - 100+140                  | 24.6           | 81.4               | 27.1           | 89.7               |
| - 140+200                  | 9.4            | 90.8               | 10.3           | 100.0              |
| - 200+ pan                 | 9.2            | 100.0              |                |                    |

LOCATION.

ERATH COUNTY 2. Road cut, east side of secondary road, 4.3 miles southwest of Stephenville. Paluxy Formation.

Sample number.-- Erath 2 (64201)

Yield after coning.-- 98.8%

Shape of grains.-- Subrounded

Graphic mean.-- 2.5 $\phi$  (0.18 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

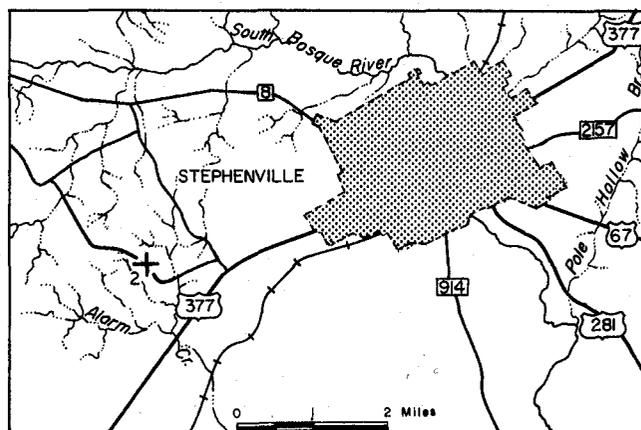
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.13%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.1            | 0.2                | 0.1            | 0.2                |
| - 40+60                    | 1.0            | 1.2                | 1.0            | 1.2                |
| - 60+80                    | 23.1           | 24.3               | 24.0           | 25.2               |
| - 80+100                   | 36.8           | 61.1               | 38.2           | 63.4               |
| - 100+140                  | 27.0           | 88.1               | 28.0           | 91.4               |
| - 140+200                  | 8.1            | 96.2               | 8.4            | 99.8               |
| - 200+ pan                 | 3.6            | 99.8               |                |                    |

LOCATION.

ERATH COUNTY 3. Road cut, west side of secondary road, between Mitchell Creek and Pony Creek, 10.5 miles east-south-east of Stephenville. Paluxy Formation.

Sample number.-- Erath 3 (64167)

Yield after coning.-- 95.1%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.5 $\phi$  (0.18 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

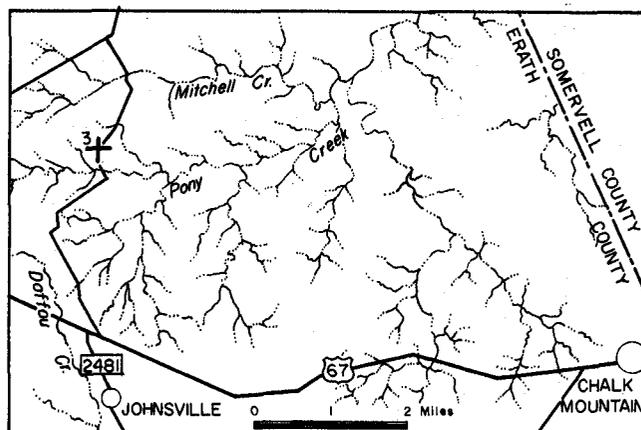
Heavy mineral content.-- 0.015%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.04%

Calcium oxide content.-- 0.06%

Alumina content.-- 0.80%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 1.7            | 1.7                | 1.8            | 1.8                |
| - 60+80                    | 17.6           | 19.3               | 19.0           | 20.8               |
| - 80+100                   | 37.0           | 56.3               | 39.9           | 60.7               |
| - 100+140                  | 27.4           | 83.7               | 29.6           | 90.3               |
| - 140+200                  | 8.8            | 92.5               | 9.5            | 99.8               |
| - 200+ pan                 | 7.1            | 99.6               |                |                    |

## LOCATION.

ERATH COUNTY 4. Road cut, north side of secondary road, 14.0 miles west-northwest of Glen Rose, 1.0 mile west of Hood County line. Twin Mountains Formation.

Sample number.-- Erath 4 (64168)

Yield after coning.-- 94.0%

Shape of grains.-- Subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

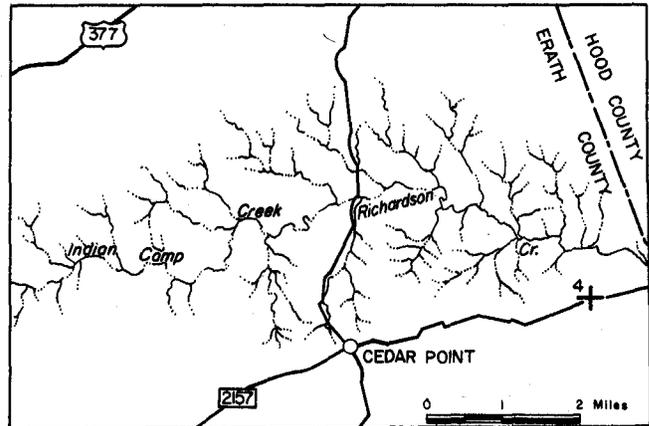
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 20+40                    | 0.1            | 0.3                | 0.1            | 0.3                |
| - 40+60                    | 0.2            | 0.5                | 0.2            | 0.5                |
| - 60+80                    | 0.4            | 0.9                | 0.5            | 1.0                |
| - 80+100                   | 3.2            | 4.1                | 3.9            | 4.9                |
| - 100+140                  | 36.3           | 40.4               | 44.0           | 48.9               |
| - 140+200                  | 42.4           | 82.8               | 51.3           | 100.2              |
| - 200+ pan                 | 17.4           | 100.2              |                |                    |

## LOCATION.

ERATH COUNTY 5. Road cut, north side of Farm Road 2157, 6.0 miles east of Stephenville. Paluxy Formation.

Sample number.-- Erath 5 (64169)

Yield after coning.-- 95.2%

Shape of grains.-- Subrounded

Graphic mean.--  $2.7\phi$  (0.16 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

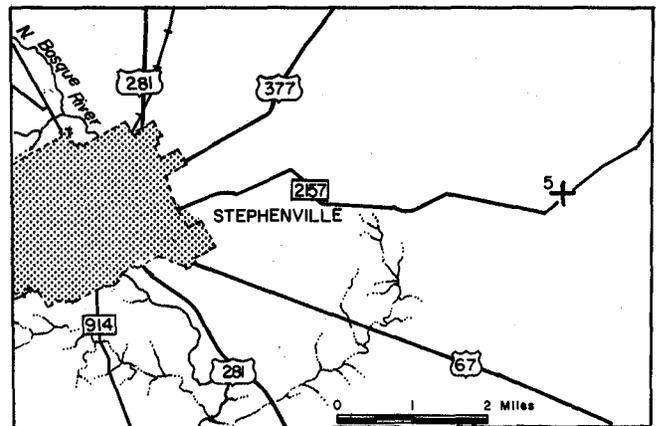
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

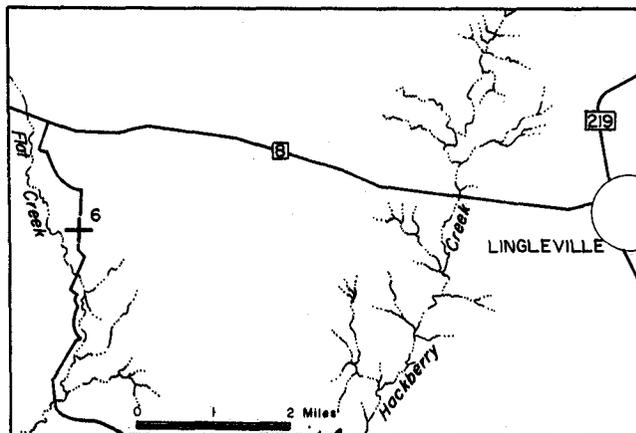
Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 40+60                    | 2.9            | 3.1                | 3.1            | 3.3                |
| - 60+80                    | 6.3            | 9.4                | 6.8            | 10.1               |
| - 80+100                   | 21.7           | 31.1               | 23.3           | 33.4               |
| - 100+140                  | 47.8           | 78.9               | 51.4           | 84.8               |
| - 140+200                  | 14.0           | 92.9               | 15.3           | 100.1              |
| - 200+ pan                 | 6.8            | 99.7               |                |                    |

LOCATION.

ERATH COUNTY 6, Stream cut at crossing of north-south secondary road, 4.0 miles southeast of Desdemona. Twin Mountains Formation (lower unit).



Sample number.--Erath 6-1A (64196)

Yield after coning.--90.3%

Shape of grains.--Subangular to subrounded

Graphic mean.--2.4 $\phi$  (0.19 mm)

Sorting index.--0.6 $\phi$  (moderately well sorted)

Heavy mineral content.--N.D.

Iron oxide content.--0.27%

Magnesium oxide content.--N.D.

Calcium oxide content.--N.D.

Alumina content.--N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.5            | 0.6                | 0.6            | 0.7                |
| - 40+60                    | 8.8            | 9.4                | 10.7           | 11.4               |
| - 60+80                    | 23.8           | 33.2               | 28.8           | 40.2               |
| - 80+100                   | 17.5           | 50.7               | 21.2           | 61.4               |
| - 100+140                  | 17.5           | 68.2               | 21.2           | 82.6               |
| - 140+200                  | 14.0           | 82.2               | 17.0           | 99.6               |
| - 200+ pan                 | 17.5           | 99.7               |                |                    |

Sample number.-- Erath 6-1 (64197)

Yield after coning.--95.7%

Shape of grains.--Subangular

Graphic mean.--1.9 $\phi$  (0.27 mm)

Sorting index.--0.8 $\phi$  (moderately sorted)

Heavy mineral content.--N.D.

Iron oxide content.--71.0%

Magnesium oxide content.--N.D.

Calcium oxide content.--N.D.

Alumina content.--N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 1.7            | 1.7                | 1.8            | 1.8                |
| - 20+40                    | 5.3            | 7.0                | 5.6            | 7.4                |
| - 40+60                    | 25.1           | 32.1               | 26.6           | 34.0               |
| - 60+80                    | 23.4           | 55.5               | 24.8           | 58.8               |
| - 80+100                   | 19.7           | 75.2               | 20.9           | 79.7               |
| - 100+140                  | 16.3           | 91.5               | 17.3           | 97.0               |
| - 140+200                  | 2.7            | 94.2               | 2.9            | 99.9               |
| - 200+ pan                 | 5.6            | 99.8               |                |                    |

Sample number.-- Erath 6-2 (64198)

Yield after coning.--96.4%

Shape of grains.-- Subangular

Graphic mean.-- $2.4\phi$  (0.19 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 70.5%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.6               | 0.6                   | 0.6               | 0.6                   |
| - 40+60                          | 2.5               | 3.1                   | 2.6               | 3.2                   |
| - 60+80                          | 19.0              | 22.1                  | 19.9              | 23.1                  |
| - 80+100                         | 38.6              | 60.7                  | 40.6              | 63.7                  |
| - 100+140                        | 29.8              | 90.5                  | 31.3              | 95.0                  |
| - 140+200                        | 4.8               | 95.3                  | 5.0               | 100.0                 |
| - 200+ pan                       | 4.7               | 100.0                 |                   |                       |

Sample number.-- Erath 6-3 (64199)

Yield after coning.-- 94.7%

Shape of grains.-- Subangular

Graphic mean.--  $2.5\phi$  (0.18 mm)

Sorting index.--  $0.35\phi$  (well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 71.0%

Magnesium oxide content.-- N.D.

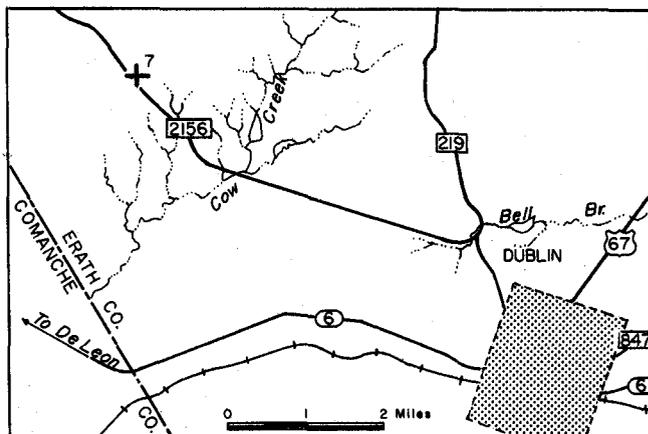
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.5               | 0.5                   | 0.5               | 0.5                   |
| - 20+40                          | 1.7               | 2.2                   | 1.8               | 2.3                   |
| - 40+60                          | 3.6               | 5.8                   | 3.9               | 6.2                   |
| - 60+80                          | 14.1              | 14.9                  | 15.1              | 21.3                  |
| - 80+100                         | 34.9              | 54.8                  | 37.4              | 58.7                  |
| - 100+140                        | 33.0              | 87.8                  | 35.3              | 94.0                  |
| - 140+200                        | 5.5               | 93.3                  | 5.9               | 99.9                  |
| - 200+ pan                       | 6.7               | 100.0                 |                   |                       |

LOCATION.

ERATH COUNTY 7. Road cut along Farm Road 2156, 6.3 miles northwest of Dublin. Paluxy Formation.



Sample number.-- Erath 7 (64200)

Yield after coning.--96.7%

Shape of grains.--Subrounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.23%

Magnesium oxide content.-- N.D.

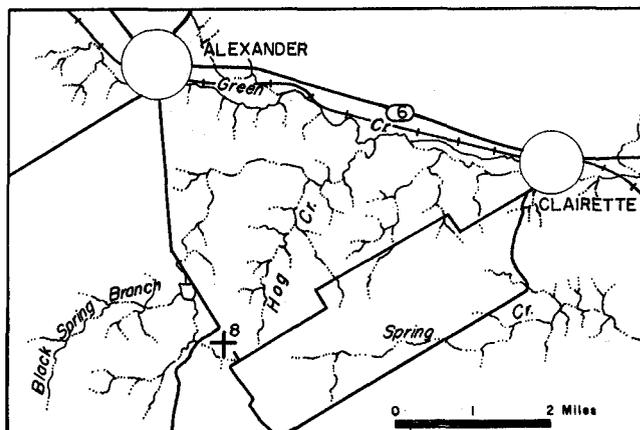
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.5            | 0.5                | 0.6            | 0.6                |
| - 20+40                    | 0.1            | 0.6                | 0.1            | 0.7                |
| - 40+60                    | 0.3            | 0.9                | 0.4            | 1.1                |
| - 60+80                    | 1.1            | 2.0                | 1.4            | 2.5                |
| - 80+100                   | 11.1           | 13.1               | 14.1           | 16.6               |
| - 100+140                  | 30.2           | 43.3               | 38.5           | 55.1               |
| - 140+200                  | 35.2           | 78.5               | 44.9           | 100.0              |
| - 200+ pan                 | 21.5           | 100.0              |                |                    |

LOCATION.

ERATH COUNTY 8. Road cut, west side of secondary road, 3.8 miles south of Alexander. Paluxy Formation.



Sample number.-- Erath 8-1 (64202)

Yield after coning.-- 98.3%

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.25 $\phi$  (very well sorted)

Heavy mineral content.-- 0.062%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 1.4            | 1.4                | 1.5            | 1.5                |
| - 60+80                    | 8.6            | 10.0               | 8.9            | 10.4               |
| - 80+100                   | 46.8           | 56.8               | 48.5           | 58.9               |
| - 100+140                  | 34.5           | 91.3               | 35.8           | 94.7               |
| - 140+200                  | 4.9            | 96.2               | 5.1            | 99.8               |
| - 200+ pan                 | 3.5            | 99.7               |                |                    |

Sample number.-- Erath 8-2 (64203)

Yield after coning.-- 97.0%

Shape of grains.-- Subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.4\phi$  (well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

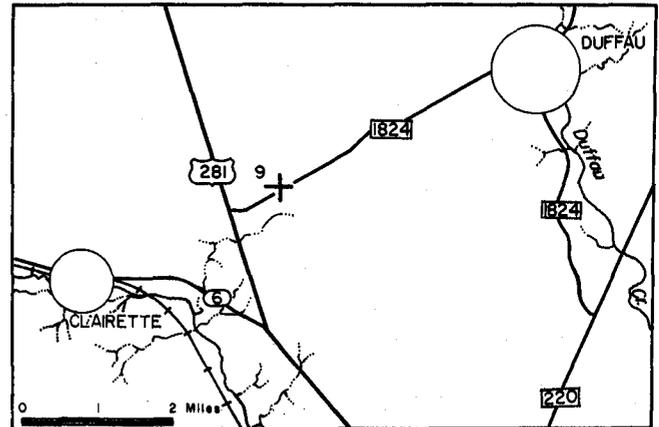
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.2               | 0.2                   | 0.2               | 0.2                   |
| - 40+60                          | 0.5               | 0.7                   | 0.6               | 0.8                   |
| - 60+80                          | 5.6               | 6.3                   | 6.3               | 7.1                   |
| - 80+100                         | 26.7              | 33.0                  | 30.3              | 37.4                  |
| - 100+140                        | 25.5              | 58.5                  | 28.9              | 66.3                  |
| - 140+200                        | 29.6              | 88.1                  | 33.6              | 99.9                  |
| - 200+ pan                       | 11.7              | 99.8                  |                   |                       |

#### LOCATION.

ERATH COUNTY 9. Road cut along Farm Road 1824, 0.5 mile east of U.S. Highway 281, 13.0 miles southeast of Stephenville. Paluxy Formation.



Sample number.-- Erath 9 (64170)

Yield after coning.-- 96.7%

Shape of grains.-- Subrounded

Graphic mean.--  $2.7\phi$  (0.16 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

Heavy mineral content.-- 0.018%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

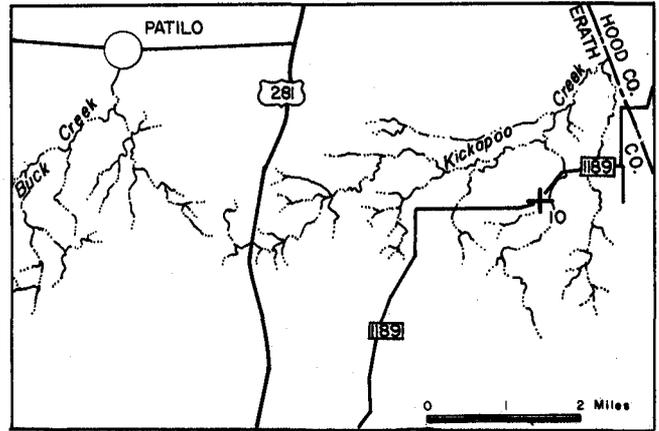
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 40+60                          | 0.2               | 0.2                   | 0.2               | 0.3                   |
| - 60+80                          | 0.9               | 1.1                   | 0.9               | 1.2                   |
| - 80+100                         | 24.9              | 26.0                  | 25.8              | 27.0                  |
| - 100+140                        | 64.7              | 90.7                  | 67.1              | 94.1                  |
| - 140+200                        | 5.6               | 96.3                  | 5.8               | 99.9                  |
| - 200+ pan                       | 3.5               | 99.8                  |                   |                       |

LOCATION.

ERATH COUNTY 10. Hillside slope, south side of Farm Road 1189, 8 miles northeast of Morgan Mill. Twin Mountains Formation (lower unit).



Sample number.-- Erath 10 (64171)

Yield after coning.-- 90.0%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $2.1\phi$  (0.24 mm)

Sorting index.--  $0.5\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N.D.

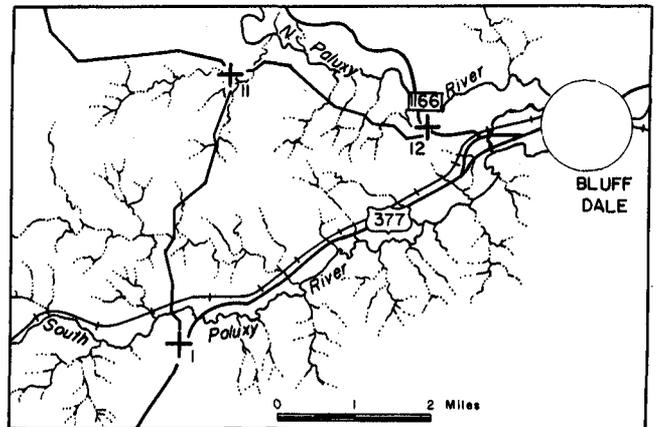
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.3            | 0.3                | 0.3            | 0.3                |
| - 40+60                    | 13.2           | 13.5               | 14.7           | 15.0               |
| - 60+80                    | 31.1           | 44.6               | 34.6           | 49.6               |
| - 80+100                   | 30.5           | 75.1               | 34.0           | 83.6               |
| - 100+140                  | 12.8           | 87.9               | 14.3           | 97.9               |
| - 140+200                  | 1.8            | 89.7               | 2.0            | 99.9               |
| - 200+ pan                 | 10.1           | 99.8               |                |                    |

LOCATION.

ERATH COUNTY 11. Stream bank immediately east of bridge on secondary road, 4.5 miles southeast of Morgan Mill. Twin Mountains Formation (upper unit).



Sample number.-- Erath 11 (64172)

Yield after coning.-- 97.0%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $2.1\phi$  (0.24 mm)

Sorting index.--  $0.4\phi$  (well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N.D.

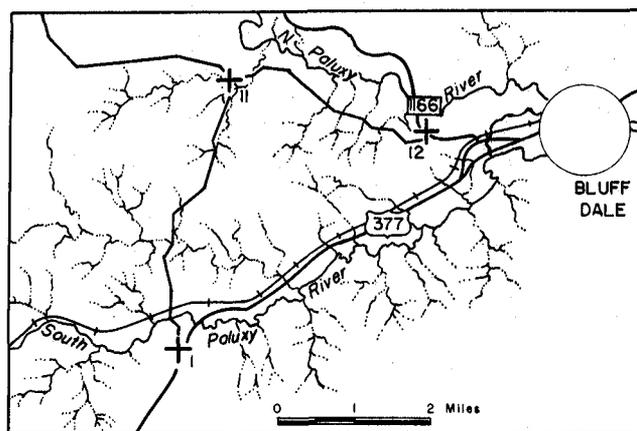
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.4            | 0.4                | 0.4            | 0.4                |
| - 20+40                    | 0.2            | 0.6                | 0.2            | 0.6                |
| - 40+60                    | 13.5           | 14.1               | 14.0           | 14.6               |
| - 60+80                    | 48.8           | 62.9               | 50.4           | 65.0               |
| - 80+100                   | 26.0           | 88.9               | 26.8           | 91.8               |
| - 100+140                  | 6.9            | 95.8               | 7.1            | 98.9               |
| - 140+200                  | 1.0            | 96.8               | 1.0            | 99.9               |
| - 200+ pan                 | 3.1            | 99.9               |                |                    |

## LOCATION.

ERATH COUNTY 12. Road cut along Farm Road 1188, immediately east of ford of North Paluxy River, 2.0 miles west of Bluff Dale. Twin Mountains Formation (upper unit).



Sample number.--Erath 12-1 (64173)

Yield after coning.-- 98.1%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.35 $\phi$  (well sorted)

Heavy mineral content.-- 0.030%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 10.4           | 10.4               | 10.6           | 10.6               |
| - 60+80                    | 60.3           | 70.7               | 61.5           | 72.1               |
| - 80+100                   | 23.0           | 93.7               | 23.5           | 95.6               |
| - 100+140                  | 2.2            | 95.9               | 2.2            | 97.8               |
| - 140+200                  | 2.2            | 98.1               | 2.2            | 100.0              |
| - 200+ pan                 | 1.9            | 100.0              |                |                    |

Sample number.-- Erath 12-2 (64174)

Yield after coning.-- 94.5%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- 0.025%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.8            | 0.8                | 0.9            | 0.9                |
| - 60+80                    | 22.1           | 22.9               | 24.3           | 25.2               |
| - 80+100                   | 47.1           | 70.0               | 51.7           | 76.9               |
| - 100+140                  | 16.0           | 86.0               | 17.6           | 94.5               |
| - 140+200                  | 5.1            | 91.1               | 5.6            | 100.1              |
| - 200+ pan                 | 8.8            | 99.9               |                |                    |

Sample number.--Erath 12-3 (64175)

Yield after coning.-- 84.8%

Shape of grains.-- Subrounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.11%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.4               | 0.4                   | 0.5               | 0.5                   |
| - 20+40                          | 0.1               | 0.5                   | 0.1               | 0.6                   |
| - 40+60                          | 0.6               | 1.1                   | 0.8               | 1.4                   |
| - 60+80                          | 6.4               | 7.5                   | 8.1               | 9.5                   |
| - 80+100                         | 15.7              | 23.2                  | 14.8              | 29.3                  |
| - 100+140                        | 40.6              | 63.8                  | 50.9              | 80.2                  |
| - 140+200                        | 15.8              | 79.6                  | 19.9              | 100.1                 |
| - 200+ pan                       | 20.3              | 99.9                  |                   |                       |

Sample number.-- Erath 12-4 (64176)

Yield after coning.-- 96.2%

Shape of grains.-- Subrounded

Graphic mean.--  $2.0\phi$  (0.25 mm)

Sorting index.--  $0.5\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.2               | 0.2                   | 0.2               | 0.2                   |
| - 20+40                          | 0.3               | 0.5                   | 0.3               | 0.5                   |
| - 40+60                          | 18.3              | 18.8                  | 19.2              | 19.7                  |
| - 60+80                          | 34.4              | 53.2                  | 36.2              | 55.9                  |
| - 80+100                         | 28.9              | 82.1                  | 30.4              | 86.3                  |
| - 100+140                        | 11.0              | 93.1                  | 11.6              | 97.9                  |
| - 140+200                        | 1.9               | 95.0                  | 2.0               | 99.9                  |
| - 200+ pan                       | 4.8               | 99.8                  |                   |                       |

## LOCATION.

ERATH COUNTY 13. Road cut along Farm Road 1715, 0.5 mile northwest of Morgan Mill. Twin Mountains Formation (upper unit).

Sample number.-- Erath 13 (64177)

Yield after coning.-- 94.8%

Shape of grains.-- Subrounded

Graphic mean.--  $2.9\phi$  (0.13 mm)

Sorting index.--  $0.24\phi$  (very well sorted)

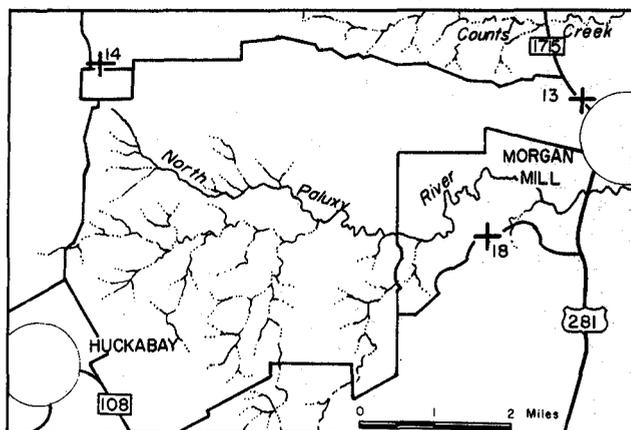
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.18%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.1            | 0.2                | 0.1            | 0.2                |
| - 40+60                    | 0.6            | 0.8                | 0.6            | 0.8                |
| - 60+80                    | 0.9            | 1.7                | 1.0            | 1.8                |
| - 80+100                   | 5.7            | 7.4                | 6.1            | 7.9                |
| - 100+140                  | 57.5           | 64.9               | 62.0           | 69.9               |
| - 140+200                  | 28.0           | 92.9               | 30.2           | 100.1              |
| - 200+ pan                 | 7.2            | 100.1              |                |                    |

## LOCATION.

ERATH COUNTY 14. Road cut along secondary road, 150 feet east of branch of Lost Creek, 7.0 miles west of Morgan Mill. Paluxy Formation.

Sample number.-- Erath 14 (64179)

Yield after coning.-- 53.3%

Shape of grains.-- Rounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.25\phi$  (very well sorted)

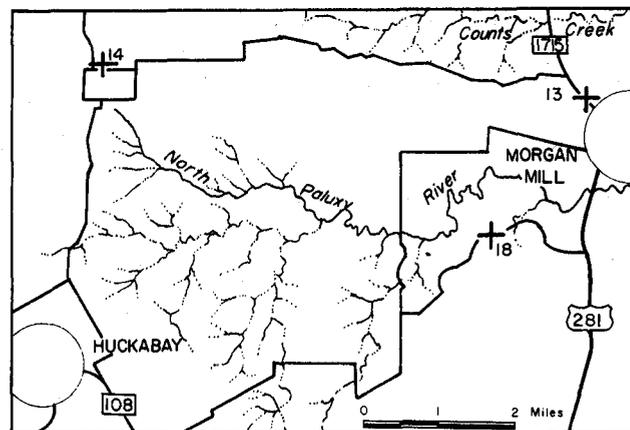
Heavy mineral content.-- N.D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

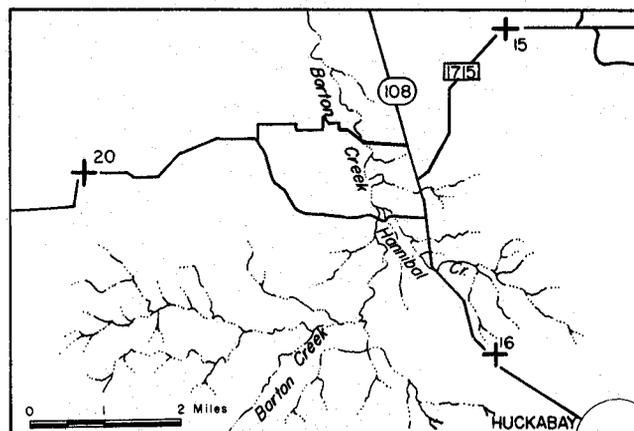
Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.1            | 0.1                |
| - 60+80                    | 0.1            | 0.1                | 0.3            | 0.4                |
| - 80+100                   | 0.7            | 0.8                | 1.7            | 2.1                |
| - 100+140                  | 6.6            | 7.4                | 16.5           | 18.6               |
| - 140+200                  | 32.5           | 39.9               | 81.5           | 100.1              |
| - 200+ pan                 | 60.1           | 100.1              |                |                    |

LOCATION.

ERATH COUNTY 15. Road cut, north side of Farm Road 1715, 5.5 miles north of Huckabay. Twin Mountains Formation (upper unit).



Sample number.--Erath 15-1 (64180)

Yield after coning.-- 94.6%

Shape of grains.-- Rounded

Graphic mean.-- 2.9 $\phi$  (0.13 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 1.0            | 1.0                | 1.1            | 1.1                |
| - 80+100                   | 11.2           | 12.2               | 12.2           | 13.3               |
| - 100+140                  | 48.1           | 60.3               | 52.5           | 65.8               |
| - 140+200                  | 31.6           | 91.9               | 34.5           | 100.3              |
| - 200+ pan                 | 8.4            | 100.3              |                |                    |

Sample number.-- Erath 15-2 (64181)

Yield after coning.-- 78.6%

Shape of grains.-- Subrounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

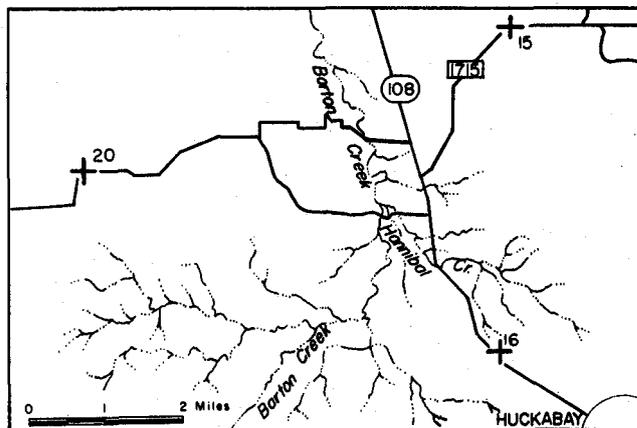
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.3            | 0.3                | 0.4            | 0.4                |
| - 20+40                    | 0.2            | 0.5                | 0.3            | 0.7                |
| - 40+60                    | 0.2            | 0.7                | 0.3            | 1.0                |
| - 60+80                    | 0.5            | 1.2                | 0.7            | 1.7                |
| - 80+100                   | 5.8            | 7.0                | 8.6            | 10.3               |
| - 100+140                  | 35.3           | 42.3               | 51.9           | 62.2               |
| - 140+200                  | 25.8           | 68.1               | 37.9           | 100.1              |
| - 200+ pan                 | 32.0           | 100.1              |                |                    |

## LOCATION.

ERATH COUNTY 16. Road cut, east side of State Highway 108, 1.8 miles northwest of Huckabay, and 12.0 miles northwest of Stephenville. Paluxy Formation.



Sample number.-- Erath 16-1 (64182)

Yield after coning.-- 93.1%

Shape of grains.-- Rounded

Graphic mean.--  $3.1\phi$  (0.12 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.1            | 0.1                |
| - 20+40                    | 0.0            | 0.0                | 0.1            | 0.2                |
| - 40+60                    | 0.0            | 0.0                | 0.1            | 0.3                |
| - 60+80                    | 0.1            | 0.1                | 0.2            | 0.5                |
| - 80+100                   | 0.9            | 1.0                | 1.9            | 2.4                |
| - 100+140                  | 13.8           | 14.8               | 28.8           | 31.2               |
| - 140+200                  | 32.8           | 47.6               | 68.7           | 99.9               |
| - 200+ pan                 | 52.2           | 99.8               |                |                    |

Sample number.-- Erath 16-2 (64183)

Yield after coning.-- 96.1%

Shape of grains.-- Rounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.25\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

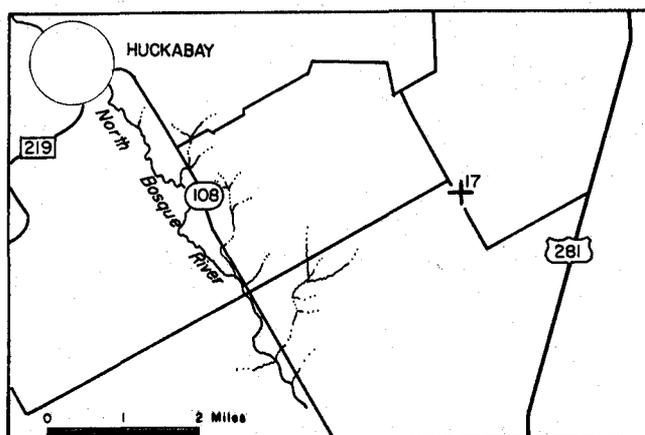
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 80+100                   | 0.4            | 0.5                | 0.6            | 0.7                |
| - 100+140                  | 11.8           | 12.3               | 17.7           | 18.4               |
| - 140+200                  | 54.5           | 66.8               | 81.5           | 99.9               |
| - 200+ pan                 | 33.0           | 99.8               |                |                    |

LOCATION.

ERATH COUNTY 17. Stream cut, branch of Straight Creek, east side of bridge on secondary road, 6.5 miles north of Stephenville. Paluxy Formation.



Sample number.--Erath 17 (64184)

Yield after coning.--97.6%

Shape of grains.--Subrounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.--N.D.

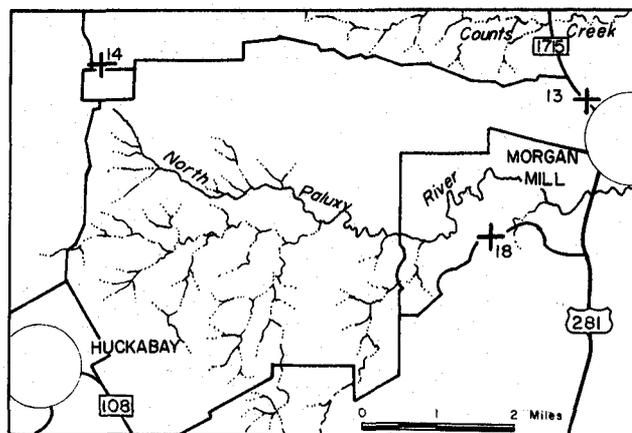
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.9            | 0.9                | 1.0            | 1.0                |
| - 80+100                   | 6.7            | 7.6                | 7.7            | 8.7                |
| - 100+140                  | 41.3           | 48.9               | 47.4           | 56.1               |
| - 140+200                  | 28.3           | 87.2               | 44.0           | 100.1              |
| - 200+ pan                 | 12.8           | 100.0              |                |                    |

LOCATION.

ERATH COUNTY 18. Stream bank and road ditch at Straight Creek, north side of secondary road, 2.2 miles southwest of Morgan Mill. Twin Mountains Formation (upper unit).



Sample number.-- Erath 18-1 (64185)

Yield after coning.--91.1%

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 1.9 $\phi$  (0.27 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.--0.024%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.--N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.6            | 0.6                | 0.7            | 0.7                |
| - 40+60                    | 26.2           | 26.8               | 29.5           | 30.2               |
| - 60+80                    | 38.3           | 65.1               | 43.1           | 73.3               |
| - 80+100                   | 16.7           | 81.8               | 18.8           | 92.1               |
| - 100+140                  | 5.7            | 87.5               | 6.4            | 98.5               |
| - 140+200                  | 1.1            | 88.6               | 1.2            | 99.7               |
| - 200+ pan                 | 11.2           | 99.8               |                |                    |

Sample number.--Erath 18-2 (64186)

Yield after coning.-- 94.1%

Shape of grains.-- Rounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 20+40                          | 0.2               | 0.3                   | 0.2               | 0.3                   |
| - 40+60                          | 1.6               | 1.9                   | 1.9               | 2.2                   |
| - 60+80                          | 7.2               | 9.1                   | 8.4               | 10.6                  |
| - 80+100                         | 22.2              | 31.3                  | 25.8              | 36.4                  |
| - 100+140                        | 38.2              | 69.5                  | 44.5              | 80.9                  |
| - 140+200                        | 16.1              | 85.6                  | 18.8              | 99.7                  |
| - 200+ pan                       | 14.0              | 99.6                  |                   |                       |

Sample number.--Erath 18-3 (64187)

Yield after coning.-- 96.7%

Shape of grains.-- Rounded

Graphic mean.--  $2.6\phi$  (0.17 mm)

Sorting index.--  $0.25\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

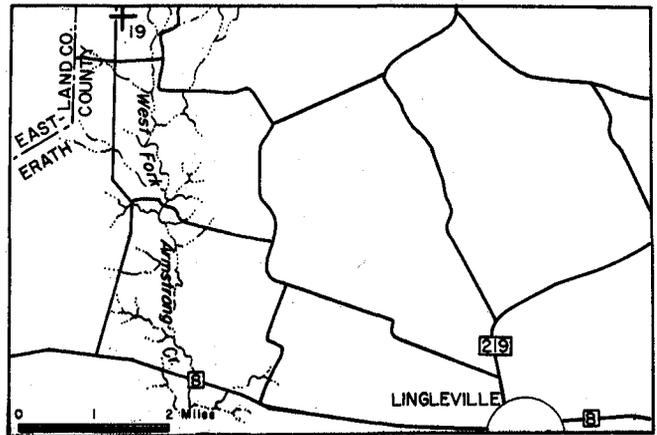
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 20+40                          | 0.2               | 0.3                   | 0.2               | 0.3                   |
| - 40+60                          | 0.4               | 0.7                   | 0.4               | 0.7                   |
| - 60+80                          | 6.3               | 7.0                   | 6.8               | 7.5                   |
| - 80+100                         | 34.4              | 41.4                  | 37.2              | 44.7                  |
| - 100+140                        | 41.8              | 83.2                  | 45.2              | 89.9                  |
| - 140+200                        | 9.2               | 92.4                  | 9.9               | 99.8                  |
| - 200+ pan                       | 7.7               | 100.1                 |                   |                       |

LOCATION.

ERATH COUNTY 19. Road cut along north-south secondary road, 4.5 miles north of Farm Road 8, 7.5 miles northwest of Lingleville. Paluxy Formation.



Sample number.--Erath 19-1 (64188)

Yield after coning.-- 97.2%

Shape of grains.-- Subangular

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 60+80                    | 23.8           | 24.0               | 27.0           | 27.2               |
| - 80+100                   | 33.2           | 57.2               | 37.6           | 64.8               |
| - 100+140                  | 10.2           | 67.4               | 11.6           | 76.4               |
| - 140+200                  | 20.7           | 88.1               | 23.5           | 99.9               |
| - 200+ pan                 | 11.7           | 99.8               |                |                    |

Sample number.-- Erath 19-2 (64189)

Yield after coning.-- 96.8%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.10%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.3            | 0.3                |
| - 40+60                    | 1.5            | 1.7                | 2.1            | 2.4                |
| - 60+80                    | 1.1            | 2.8                | 1.5            | 3.9                |
| - 80+100                   | 3.7            | 6.5                | 5.1            | 9.0                |
| - 100+140                  | 27.8           | 34.3               | 37.9           | 46.9               |
| - 140+200                  | 38.9           | 73.2               | 53.1           | 100.0              |
| - 200+ pan                 | 26.7           | 99.9               |                |                    |

## LOCATION.

ERATH COUNTY 20. Road cut and ditch, north side of secondary road, 7.5 miles northwest of Huckabay. Twin Mountains Formation (lower unit).

Sample number.-- Erath 20-1 (64190)

Yield after coning.-- 93.8%

Shape of grains.-- Subangular to rounded

Graphic mean.--  $1.7\phi$  (0.31 mm)

Sorting index.--  $0.6\phi$  (moderately well sorted)

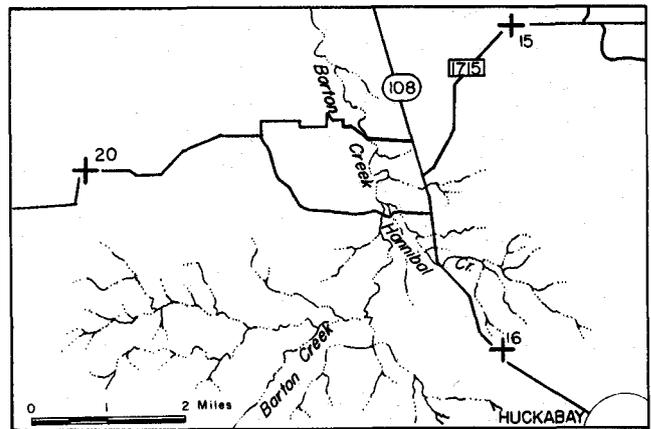
Heavy mineral content.-- 0.020%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 20+40                    | 1.4            | 1.6                | 1.5            | 1.7                |
| - 40+60                    | 36.0           | 37.6               | 39.2           | 40.9               |
| - 60+80                    | 39.4           | 77.0               | 42.9           | 83.8               |
| - 80+100                   | 9.5            | 86.5               | 10.3           | 94.1               |
| - 100+140                  | 3.7            | 90.2               | 4.0            | 98.1               |
| - 140+200                  | 1.7            | 91.9               | 1.8            | 99.9               |
| - 200+ pan                 | 9.2            | 100.1              |                |                    |

Sample number.-- Erath 20-2 (64191)

Yield after coning.-- 95.2%

Shape of grains.-- Subangular to rounded

Graphic mean.--  $1.6\phi$  (0.34 mm)

Sorting index.--  $0.5\phi$  (moderately well sorted)

Heavy mineral content.-- 0.009%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 1.6            | 1.7                | 1.7            | 1.8                |
| - 40+60                    | 40.8           | 42.5               | 43.1           | 44.9               |
| - 60+80                    | 43.6           | 86.1               | 46.1           | 91.0               |
| - 80+100                   | 6.6            | 92.7               | 7.0            | 98.0               |
| - 100+140                  | 1.5            | 94.2               | 1.6            | 99.6               |
| - 140+200                  | 0.5            | 94.7               | 0.5            | 100.1              |
| - 200+ pan                 | 5.3            | 100.0              |                |                    |

Sample number.-- Erath 20-3 (64192)

Yield after coning.-- 95.7%

Shape of grains.-- Subangular to rounded

Graphic mean.--  $1.7\phi$  (0.31 mm)

Sorting index.--  $0.5\phi$  (moderately well sorted)

Heavy mineral content.-- 0.022%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 20+40                          | 2.3               | 2.4                   | 2.4               | 2.5                   |
| - 40+60                          | 30.4              | 32.8                  | 31.9              | 34.4                  |
| - 60+80                          | 41.8              | 74.6                  | 43.8              | 78.2                  |
| - 80+100                         | 17.2              | 91.8                  | 18.1              | 96.3                  |
| - 100+140                        | 3.3               | 95.1                  | 3.5               | 99.8                  |
| - 140+200                        | 0.2               | 95.3                  | 0.2               | 100.0                 |
| - 200+ pan                       | 4.6               | 99.9                  |                   |                       |

Sample number.-- Erath 20-4 (64193)

Yield after coning.-- 95.4%

Shape of grains.-- Subangular

Graphic mean.--  $1.6\phi$  (0.34 mm)

Sorting index.--  $0.5\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.13%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.2               | 0.2                   | 0.2               | 0.2                   |
| - 20+40                          | 3.0               | 3.2                   | 3.2               | 3.4                   |
| - 40+60                          | 46.6              | 49.8                  | 49.0              | 52.4                  |
| - 60+80                          | 37.3              | 87.1                  | 39.2              | 91.6                  |
| - 80+100                         | 6.4               | 93.5                  | 6.7               | 98.3                  |
| - 100+140                        | 1.5               | 95.0                  | 1.6               | 99.9                  |
| - 140+200                        | 0.1               | 95.1                  | 0.1               | 100.0                 |
| - 200+ pan                       | 4.8               | 99.9                  |                   |                       |

Sample number.-- Erath 20-5 (64194)

Yield after coning.-- 95.9%

Shape of grains.-- Subrounded

Graphic mean.--  $2.0\phi$  (0.25 mm)

Sorting index.--  $0.5\phi$  (moderately well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.8               | 0.8                   | 0.9               | 0.9                   |
| - 40+60                          | 20.6              | 21.4                  | 21.9              | 22.8                  |
| - 60+80                          | 46.0              | 67.4                  | 48.9              | 71.7                  |
| - 80+100                         | 16.6              | 84.0                  | 17.6              | 89.3                  |
| - 100+140                        | 7.9               | 91.9                  | 8.4               | 97.7                  |
| - 140+200                        | 2.0               | 93.9                  | 2.1               | 99.8                  |
| - 200+ pan                       | 5.8               | 99.7                  |                   |                       |

Sample number.-- Erath 20-6 (64195)

Yield after coning.-- 97.8%

Shape of grains.-- Subrounded

Graphic mean.--  $2.1\phi$  (0.24 mm)

Sorting index.--  $0.4\phi$  (well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.11%

Magnesium oxide content.-- N.D.

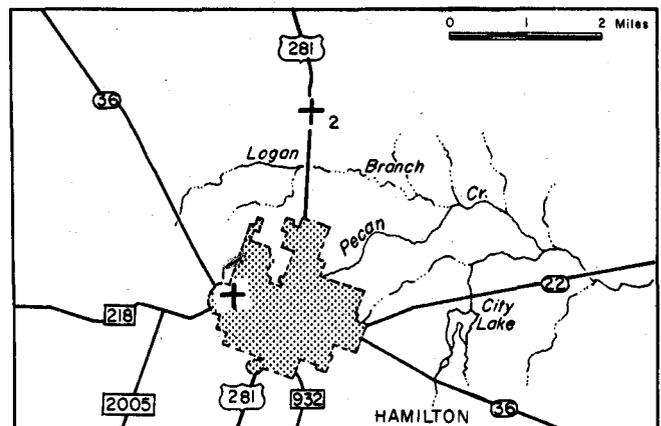
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.3               | 0.3                   | 0.3               | 0.3                   |
| - 40+60                          | 13.2              | 13.5                  | 13.6              | 13.9                  |
| - 60+80                          | 50.0              | 63.5                  | 51.5              | 65.4                  |
| - 80+100                         | 24.3              | 87.8                  | 25.0              | 90.4                  |
| - 100+140                        | 8.0               | 95.8                  | 8.2               | 98.6                  |
| - 140+200                        | 1.3               | 97.1                  | 1.3               | 99.9                  |
| - 200+ pan                       | 2.8               | 99.9                  |                   |                       |

#### LOCATION.

HAMILTON COUNTY 1. Road cut, northwest corner of intersection of State Highway 36 and Farm Road 218, west city limits of Hamilton. Paluxy Formation.



Sample number.-- Hamilton 1 (64204)

Yield after coning.-- 97.9%

Shape of grains.-- Rounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N.D.

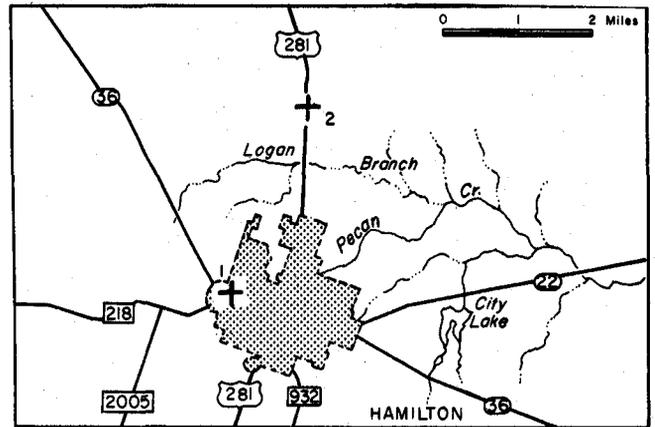
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 40+60                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 60+80                          | 0.3               | 0.3                   | 0.3               | 0.3                   |
| - 80+100                         | 2.4               | 2.7                   | 2.7               | 3.0                   |
| - 100+140                        | 39.8              | 42.5                  | 45.6              | 48.6                  |
| - 140+200                        | 44.8              | 87.3                  | 51.4              | 100.0                 |
| - 200+ pan                       | 12.7              | 100.0                 |                   |                       |

LOCATION.

HAMILTON COUNTY 2. Road cut along U. S. Highway 281, 1.7 miles north of Hamilton. Paluxy Formation.



Sample number.-- Hamilton 2 (64205)

Yield after coning.--97.6%

Shape of grains.-- Rounded

Graphic mean.-- 3.1φ (0.12 mm)

Sorting index.-- 0.3φ (very well sorted)

Heavy mineral content.-- N.D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N.D.

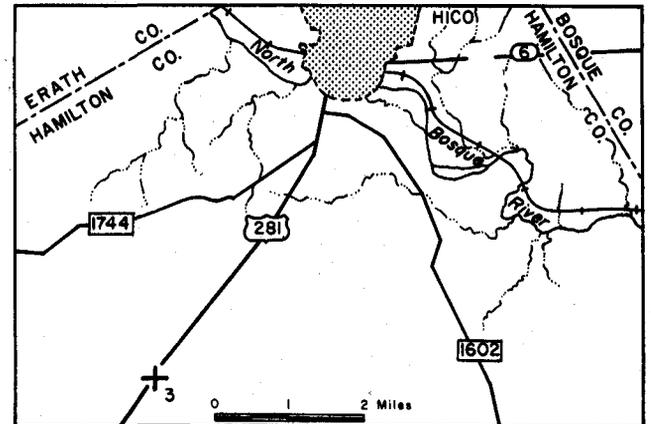
Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.2            | 0.3                | 0.3            | 0.4                |
| - 80+100                   | 1.4            | 1.7                | 1.9            | 2.3                |
| - 100+140                  | 18.5           | 20.2               | 24.4           | 26.7               |
| - 140+200                  | 55.6           | 75.8               | 73.4           | 100.1              |
| - 200+ pan                 | 24.0           | 99.8               |                |                    |

LOCATION.

HAMILTON COUNTY 3. Road cut along U. S. Highway 281, 4.4 miles southwest of Hico. Paluxy Formation.



Sample number.-- Hamilton 3 (64207)

Yield after coning.-- 98.9%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 3.0φ (0.125 mm)

Sorting index.-- 0.3φ (very well sorted)

Heavy mineral content.-- 0.059%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N.D.

Calcium oxide content.-- N.D.

Alumina content.-- N.D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 3.1            | 3.1                | 3.8            | 3.8                |
| - 20+40                    | 0.0            | 3.1                | 0.0            | 3.8                |
| - 40+60                    | 0.1            | 3.2                | 0.1            | 3.9                |
| - 60+80                    | 0.1            | 3.3                | 0.1            | 4.0                |
| - 80+100                   | 3.2            | 6.5                | 4.0            | 8.0                |
| - 100+140                  | 30.4           | 39.9               | 37.8           | 45.8               |
| - 140+200                  | 43.7           | 80.6               | 54.3           | 100.1              |
| - 200+ pan                 | 19.5           | 100.1              |                |                    |

## LOCATION.

HOOD COUNTY 1. Road cut and hill slope, west side of secondary road, 0.5 mile east of Fall Creek Church, 9.0 miles east-southeast of Granbury. Paluxy Formation.

Sample number.-- Hood 1 (64211)

Yield after coning.-- 97.8%

Shape of grains.-- Subangular to rounded

Graphic mean.--  $2.9\phi$  (0.13 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

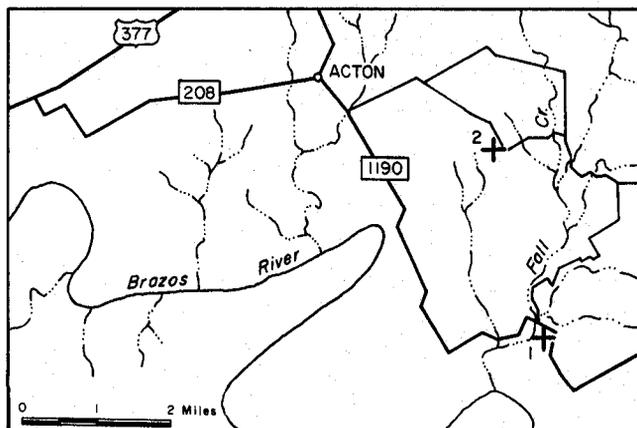
Heavy mineral content.-- 0.026%

Iron oxide content.-- 0.036%

Magnesium oxide content.-- 0.02%

Calcium oxide content.-- 0.06%

Alumina content.-- 0.83%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.3            | 0.3                | 0.3            | 0.3                |
| - 60+80                    | 3.0            | 3.3                | 3.2            | 3.5                |
| - 80+100                   | 18.0           | 21.3               | 19.1           | 22.6               |
| - 100+140                  | 49.4           | 70.7               | 52.5           | 75.1               |
| - 140+200                  | 23.2           | 93.9               | 24.7           | 99.8               |
| - 200+ pan                 | 6.0            | 99.9               |                |                    |

## LOCATION.

HOOD COUNTY 2. Stream cut along secondary road, 2.5 miles east-southeast of Acton. Paluxy Formation.

Sample number.-- Hood 2 (64208)

Yield after coning.-- 97.6%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

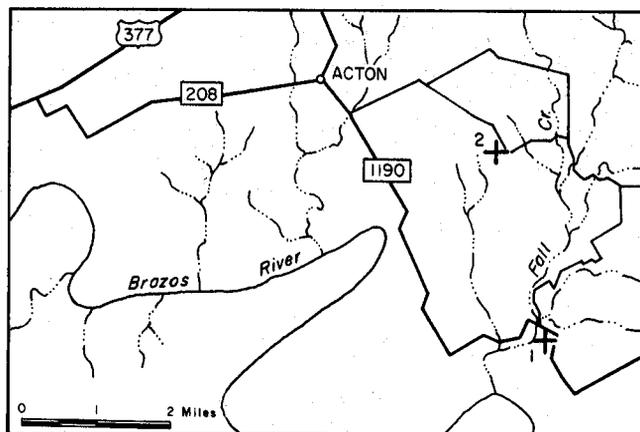
Heavy mineral content.-- 0.041%

Iron oxide content.-- 0.035%

Magnesium oxide content.-- 0.04%

Calcium oxide content.-- 0.02%

Alumina content.-- 1.02%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.3            | 0.3                | 0.3            | 0.3                |
| - 60+80                    | 3.4            | 3.7                | 3.6            | 3.9                |
| - 80+100                   | 19.1           | 22.8               | 20.4           | 24.3               |
| - 100+140                  | 50.0           | 72.8               | 53.4           | 77.7               |
| - 140+200                  | 21.0           | 93.8               | 22.4           | 100.1              |
| - 200+ pan                 | 6.2            | 100.0              |                |                    |

LOCATION.

HOOD COUNTY 3. Railroad cut, north side of Santa Fe tracks, 2.0 miles north-east of Tolar. Paluxy Formation.

Sample number.-- Hood 3 (64213)

Yield after coning.-- 57.3%

Shape of grains.-- Subrounded

Graphic mean.--  $2.5\phi$  (0.18 mm)

Sorting index.--  $0.5\phi$  (well sorted)

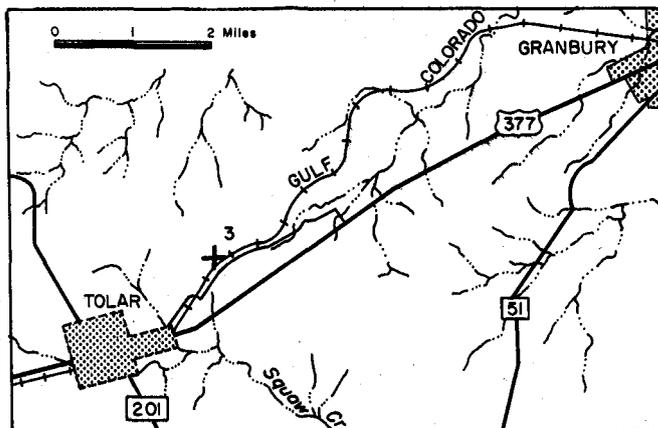
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.15%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.2            | 0.2                | 0.4            | 0.4                |
| - 20+40                    | 0.2            | 0.4                | 0.4            | 0.8                |
| - 40+60                    | 3.0            | 3.4                | 6.0            | 6.8                |
| - 60+80                    | 8.7            | 12.1               | 17.6           | 24.4               |
| - 80+100                   | 11.5           | 23.6               | 23.2           | 47.6               |
| - 100+140                  | 17.6           | 41.2               | 35.6           | 83.2               |
| - 140+200                  | 8.2            | 49.4               | 16.5           | 99.7               |
| - 200+ pan                 | 50.5           | 99.9               |                |                    |

LOCATION.

HOOD COUNTY 4. Stream cut along Robinson Creek at crossing of Farm Road 4, 8.0 miles west-northwest of Granbury. Twin Mountains Formation (upper unit).

Sample number.-- Hood 4-1 (64209)

Yield after coning.-- 99.9%

Shape of grains.-- Subrounded to rounded

Graphic mean.--  $1.7\phi$  (0.31 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

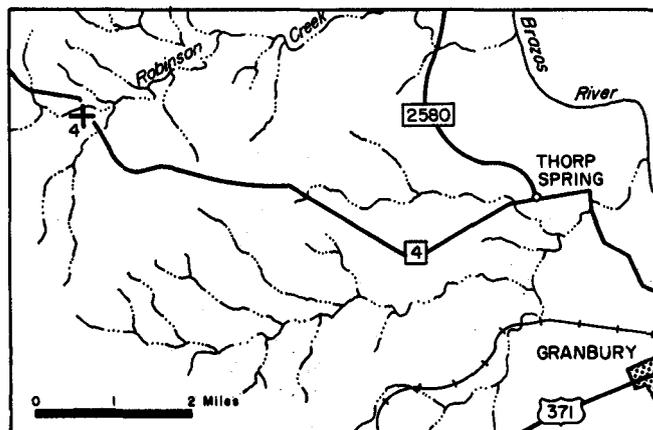
Heavy mineral content.-- 0.034%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 20+40                    | 1.1            | 1.3                | 1.1            | 1.3                |
| - 40+60                    | 26.4           | 27.7               | 26.4           | 27.7               |
| - 60+80                    | 58.9           | 86.6               | 58.9           | 86.6               |
| - 80+100                   | 11.3           | 97.9               | 11.3           | 97.9               |
| - 100+140                  | 1.6            | 99.5               | 1.6            | 99.5               |
| - 140+200                  | 0.2            | 99.7               | 0.2            | 99.7               |
| - 200+ pan                 | 0.3            | 100.0              |                |                    |

Sample number.-- Hood 4-2 (64210)

Yield after coning.-- 98.9%

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.10%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

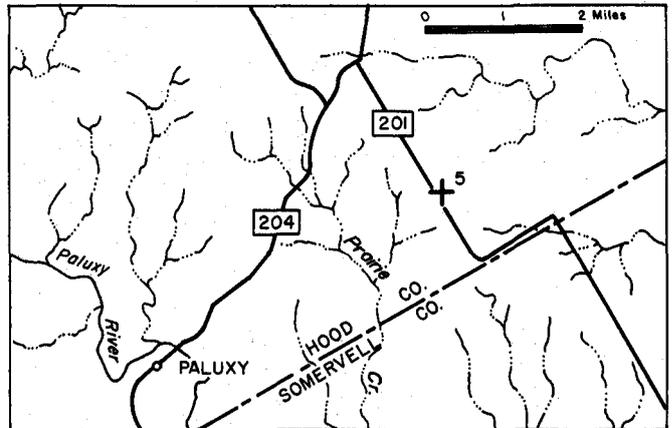
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.2               | 0.2                   | 0.2               | 0.2                   |
| - 40+60                          | 15.8              | 16.0                  | 16.1              | 16.3                  |
| - 60+80                          | 45.0              | 61.0                  | 45.8              | 62.1                  |
| - 80+100                         | 26.0              | 87.0                  | 26.4              | 88.5                  |
| - 100+140                        | 9.7               | 96.7                  | 9.9               | 98.4                  |
| - 140+200                        | 1.6               | 98.3                  | 1.6               | 100.0                 |
| - 200+ pan                       | 1.6               | 99.9                  |                   |                       |

#### LOCATION.

HOOD COUNTY 5. Road cut, east side of Farm Road 201, 1.0 mile north of Somervell County line, 7.0 miles northwest of Glen Rose. Paluxy Formation.



Sample number.-- Hood 5 (64212)

Yield after coning.-- 93.9%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.03%

Calcium oxide content.-- 0.04%

Alumina content.-- 0.89%

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 40+60                          | 0.2               | 0.2                   | 0.4               | 0.4                   |
| - 60+80                          | 0.3               | 0.5                   | 0.7               | 1.1                   |
| - 80+100                         | 1.8               | 2.3                   | 4.2               | 5.3                   |
| - 100+140                        | 8.3               | 10.6                  | 19.2              | 24.5                  |
| - 140+200                        | 32.9              | 43.5                  | 76.0              | 100.5                 |
| - 200+ pan                       | 56.7              | 100.2                 |                   |                       |

LOCATION.

MONTAGUE COUNTY 1. Road cut along Farm Road 922 at Bingham Creek crossing, 3.7 miles southeast of Forestburg. Antlers Formation.

Sample number.-- Montague 1 (64215)

Yield after coning.-- 91.8%

Shape of grains.-- Rounded

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

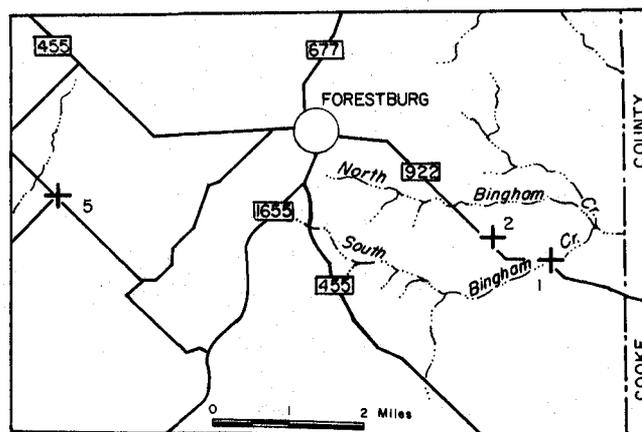
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.4            | 0.5                | 0.6            | 0.7                |
| - 80+100                   | 3.4            | 3.9                | 5.6            | 6.3                |
| - 100+140                  | 20.0           | 23.9               | 33.0           | 39.3               |
| - 140+200                  | 36.6           | 60.5               | 60.5           | 99.8               |
| - 200+ pan                 | 39.6           | 100.1              |                |                    |

LOCATION.

MONTAGUE COUNTY 2. Road cut along Farm Road 922, 2.8 miles southeast of Forestburg. Antlers Formation.

Sample number.-- Montague 2 (64217)

Yield after coning.-- 93.5%

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 2.3 $\phi$  (0.21 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

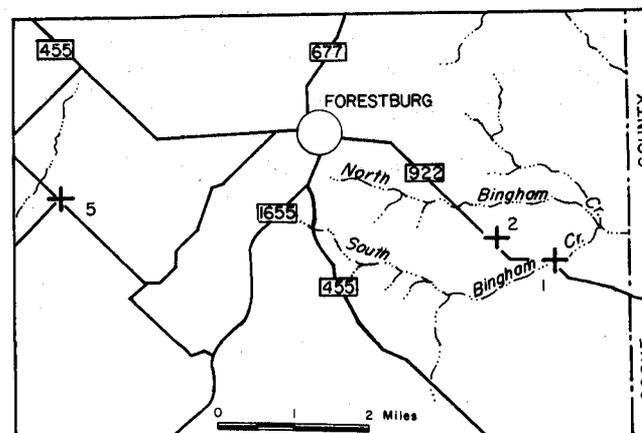
Heavy mineral content.-- 0.009%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.7            | 0.8                | 0.8            | 0.9                |
| - 40+60                    | 6.8            | 7.6                | 7.3            | 8.2                |
| - 60+80                    | 22.2           | 29.8               | 24.0           | 32.2               |
| - 80+100                   | 31.4           | 61.2               | 33.8           | 66.0               |
| - 100+140                  | 25.5           | 86.7               | 27.5           | 93.5               |
| - 140+200                  | 5.9            | 92.6               | 6.4            | 99.9               |
| - 200+ pan                 | 7.2            | 99.8               |                |                    |

## LOCATION.

MONTAGUE COUNTY 3. Road cut along gravel road, 4.6 miles directly north of Forestburg. Antlers Formation.

Sample number.-- Montague 3 (64233)

Yield after coning.-- 92.3%

Shape of grains.-- Angular to subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.4\phi$  (well sorted)

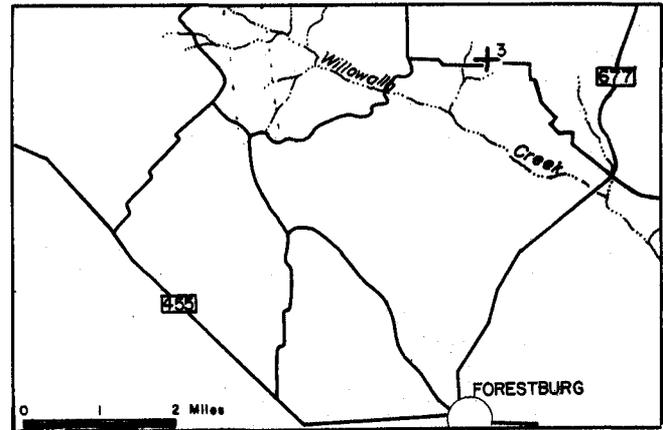
Heavy mineral content.-- 0.021%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 1.4            | 1.4                | 1.4            | 1.4                |
| - 40+60                    | 1.7            | 3.1                | 2.3            | 3.2                |
| - 60+80                    | 2.7            | 5.8                | 3.6            | 6.8                |
| - 80+100                   | 6.9            | 12.7               | 9.2            | 16.0               |
| - 100+140                  | 18.4           | 31.1               | 24.6           | 40.6               |
| - 140+200                  | 44.4           | 75.5               | 59.5           | 100.1              |
| - 200+ pan                 | 24.3           | 99.8               |                |                    |

## LOCATION.

MONTAGUE COUNTY 4. Road cut along Sunset-Forestburg road (gravel road extension of Farm Road 1749), 6.5 miles northeast of Sunset. Antlers Formation.

Sample number.-- Montague 4 (64218)

Yield after coning.-- 95.3%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.4\phi$  (well sorted)

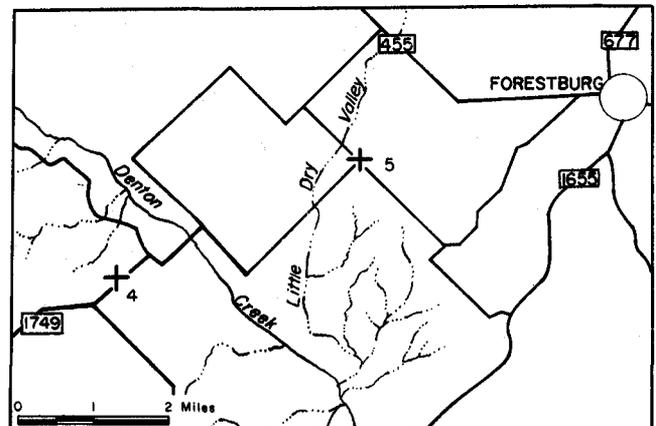
Heavy mineral content.-- 0.009%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

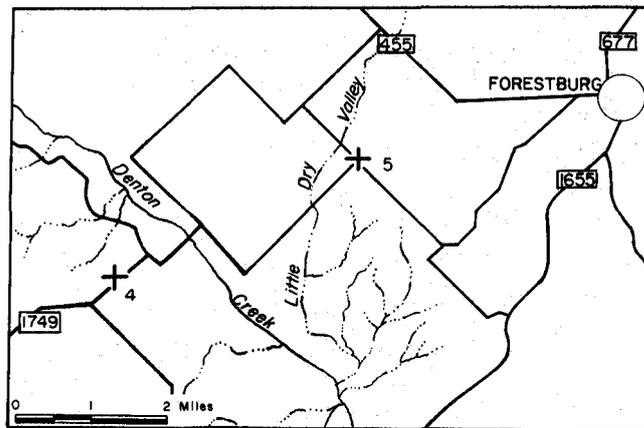
Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 2.2            | 2.2                | 2.8            | 2.8                |
| - 80+100                   | 16.3           | 18.5               | 20.4           | 23.2               |
| - 100+140                  | 28.2           | 46.7               | 35.2           | 58.4               |
| - 140+200                  | 33.3           | 80.0               | 41.6           | 100.0              |
| - 200+ pan                 | 19.9           | 99.9               |                |                    |

LOCATION.

MONTAGUE COUNTY 5. Road cut along Sunset-Forestburg road, at right-angle turn 0.2 mile south of Dewey, 3.4 miles west of Forestburg. Antlers Formation.



Sample number.-- Montague 5-1 (64219)

Yield after coning.-- 88.2%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.4\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.1            | 0.1                |
| - 60+80                    | 0.1            | 0.1                | 0.2            | 0.3                |
| - 80+100                   | 0.9            | 1.0                | 1.9            | 2.2                |
| - 100+140                  | 5.9            | 6.9                | 11.9           | 14.1               |
| - 140+200                  | 42.8           | 49.7               | 86.0           | 100.1              |
| - 200+ pan                 | 50.2           | 99.9               |                |                    |

Sample number.-- Montague 5-2 (64220)

Yield after coning.-- 95.9%

Shape of grains.-- Rounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.1            | 0.1                | 0.3            | 0.3                |
| - 80+100                   | 0.9            | 1.0                | 2.2            | 2.5                |
| - 100+140                  | 4.5            | 5.5                | 10.5           | 13.0               |
| - 140+200                  | 37.4           | 42.9               | 87.0           | 100.0              |
| - 200+ pan                 | 56.9           | 99.8               |                |                    |

## LOCATION.

MONTAGUE COUNTY 6. Road cut along county road, 3.0 miles west-northwest of Montague. Antlers Formation.

Sample number.-- Montague 6 (64221)

Yield after coning.-- 94.8%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.35\phi$  (well sorted)

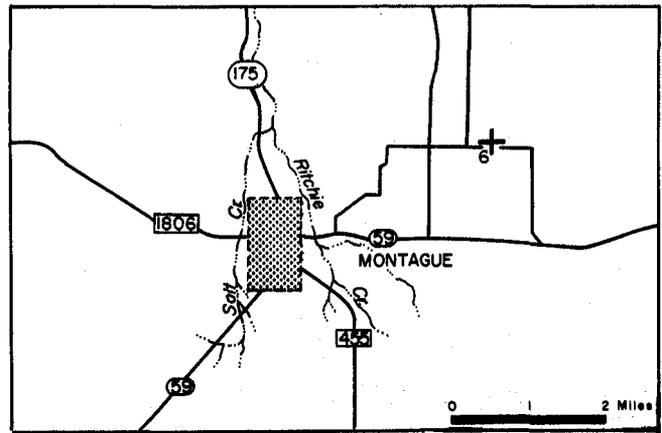
Heavy mineral content.-- 0.037%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.5            | 0.5                | 0.6            | 0.6                |
| - 60+80                    | 3.7            | 4.2                | 4.8            | 5.4                |
| - 80+100                   | 7.9            | 12.1               | 10.3           | 15.7               |
| - 100+140                  | 25.1           | 37.2               | 32.6           | 48.3               |
| - 140+200                  | 39.8           | 77.0               | 51.7           | 100.0              |
| - 200+ pan                 | 23.0           | 100.0              |                |                    |

## LOCATION.

MONTAGUE COUNTY 7. Road cut along gravel road north of State Highway 59, 4.0 miles west of Saint Jo. Antlers Formation.

Sample number.-- Montague 7 (64222)

Yield after coning.-- 67.7%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $2.7\phi$  (0.15 mm)

Sorting index.--  $0.6\phi$  (moderately well sorted)

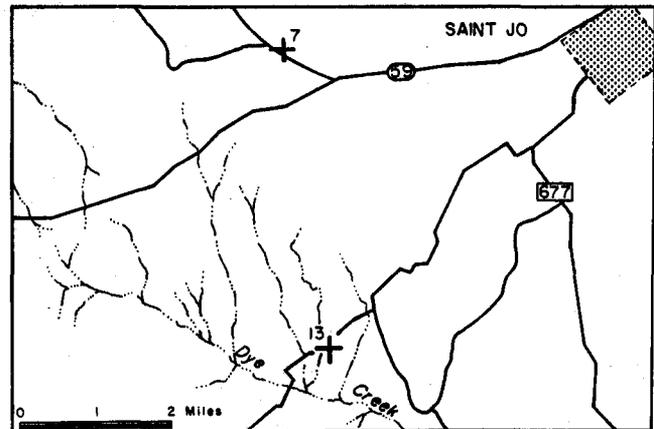
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

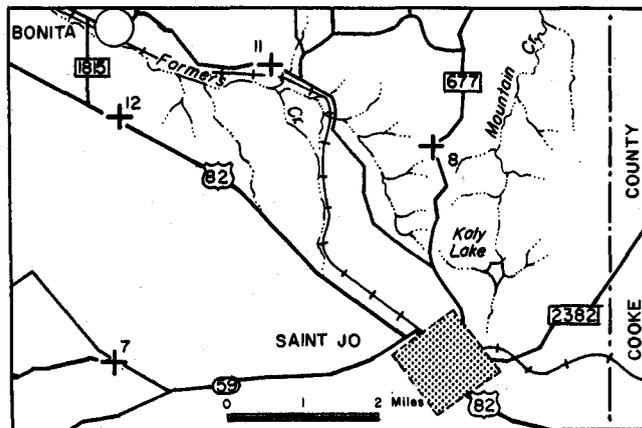
Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.3            | 0.3                | 0.7            | 0.7                |
| - 20+40                    | 0.4            | 0.7                | 1.0            | 1.7                |
| - 40+60                    | 3.2            | 3.9                | 7.4            | 9.1                |
| - 60+80                    | 6.1            | 10.0               | 14.2           | 23.3               |
| - 80+100                   | 4.8            | 14.8               | 11.0           | 34.3               |
| - 100+140                  | 10.1           | 24.9               | 23.0           | 57.3               |
| - 140+200                  | 18.5           | 43.4               | 42.8           | 100.1              |
| - 200+ pan                 | 56.7           | 100.1              |                |                    |

LOCATION.

MONTAGUE COUNTY 8. Road cut along Farm Road 677, 2.0 miles north of Saint Jo. Antlers Formation.



Sample number.-- Montague 8-1 (64223)

Yield after coning.-- 85.9%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.9 $\phi$  (0.13 mm)

Sorting index.-- 0.35 $\phi$  (well sorted)

Heavy mineral content.-- 0.062%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 0.3            | 0.4                | 0.4            | 0.5                |
| - 60+80                    | 3.4            | 3.8                | 4.5            | 5.0                |
| - 80+100                   | 14.6           | 18.4               | 19.5           | 24.5               |
| - 100+140                  | 22.6           | 51.0               | 43.4           | 67.9               |
| - 140+200                  | 24.2           | 75.2               | 32.2           | 100.1              |
| - 200+ pan                 | 25.0           | 100.2              |                |                    |

Sample number.-- Montague 8-2 (64224)

Yield after coning.-- 71.5%

Shape of grains.-- Subangular

Graphic mean.-- 2.5 $\phi$  (0.18 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- > 1.0%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 1.3            | 1.3                | 2.9            | 2.9                |
| - 40+60                    | 3.0            | 4.3                | 6.4            | 9.3                |
| - 60+80                    | 10.9           | 15.2               | 23.7           | 33.0               |
| - 80+100                   | 12.7           | 27.9               | 27.5           | 60.5               |
| - 100+140                  | 7.2            | 35.1               | 15.7           | 76.2               |
| - 140+200                  | 11.0           | 46.1               | 23.8           | 100.0              |
| - 200+ pan                 | 53.9           | 100.0              |                |                    |

Sample number.-- Montague 8-3 (64225)

Yield after coning.-- 89.0%

Shape of grains.-- Subangular to well rounded

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.022%

Iron oxide content.-- 0.036%

Magnesium oxide content.-- 0.05%

Calcium oxide content.-- 0.04%

Alumina content.-- 1.03%

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.2               | 0.2                   | 0.2               | 0.2                   |
| - 40+60                          | 2.9               | 3.1                   | 3.6               | 3.8                   |
| - 60+80                          | 19.0              | 22.1                  | 23.8              | 27.6                  |
| - 80+100                         | 19.1              | 41.2                  | 24.0              | 51.6                  |
| - 100+140                        | 21.4              | 62.6                  | 26.8              | 78.4                  |
| - 140+200                        | 17.4              | 80.0                  | 21.8              | 100.2                 |
| - 200+ pan                       | 20.3              | 100.3                 |                   |                       |

Sample number.-- Montague 8-4 (64226)

Yield after coning.-- 97.8%

Shape of grains.-- Subangular to well rounded

Graphic mean.-- 1.6 $\phi$  (0.34 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.014%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 20+40                          | 3.4               | 3.5                   | 3.5               | 3.6                   |
| - 40+60                          | 33.5              | 37.0                  | 34.5              | 38.1                  |
| - 60+80                          | 40.6              | 77.6                  | 41.8              | 79.9                  |
| - 80+100                         | 15.0              | 92.6                  | 15.5              | 95.4                  |
| - 100+140                        | 2.1               | 94.7                  | 2.2               | 97.6                  |
| - 140+200                        | 2.1               | 96.8                  | 2.2               | 99.8                  |
| - 200+ pan                       | 2.8               | 99.6                  |                   |                       |

Sample number.-- Montague 8-5 (64227)

Yield after coning.-- 98.4%

Shape of grains.-- Subangular

Graphic mean.-- 2.0 $\phi$  (0.25 mm)

Sorting index.-- 0.7 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.12%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.3               | 0.3                   | 0.3               | 0.3                   |
| - 20+40                          | 2.8               | 3.1                   | 2.9               | 3.2                   |
| - 40+60                          | 23.6              | 26.7                  | 24.5              | 27.7                  |
| - 60+80                          | 32.7              | 59.4                  | 33.9              | 61.6                  |
| - 80+100                         | 16.8              | 76.2                  | 17.4              | 79.0                  |
| - 100+140                        | 13.7              | 89.9                  | 14.2              | 93.2                  |
| - 140+200                        | 6.3               | 96.2                  | 6.5               | 99.7                  |
| - 200+ pan                       | 3.6               | 99.8                  |                   |                       |

LOCATION.

MONTAGUE COUNTY 9. Road cut, west side of Farm Road 677, south side of Cobb Hollow crossing, 5.5 miles north of Saint Jo. Antlers Formation.

Sample number.-- Montague 9 (64228)

Yield after coning.-- 84.8%

Shape of grains.-- Rounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

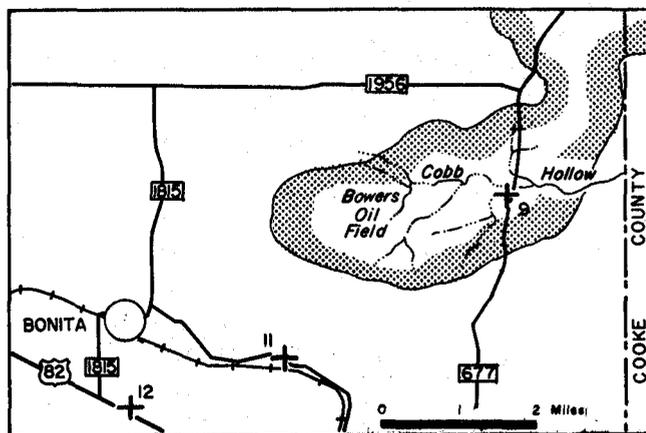
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.18%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 1.2            | 1.2                | 2.0            | 2.0                |
| - 60+80                    | 2.2            | 3.4                | 3.7            | 5.7                |
| - 80+100                   | 3.7            | 7.1                | 6.2            | 11.9               |
| - 100+140                  | 10.4           | 17.5               | 17.6           | 29.5               |
| - 140+200                  | 41.9           | 59.4               | 70.6           | 100.1              |
| - 200+ pan                 | 40.7           | 100.1              |                |                    |

LOCATION.

MONTAGUE COUNTY 10. Road cut along gravel road, 1.7 miles west of Illinois Bend. Antlers Formation.

Sample number.-- Montague 10 (64229)

Yield after coning.-- 93.3%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.3 $\phi$  (0.21 mm)

Sorting index.-- 1.0 $\phi$  (poorly sorted)

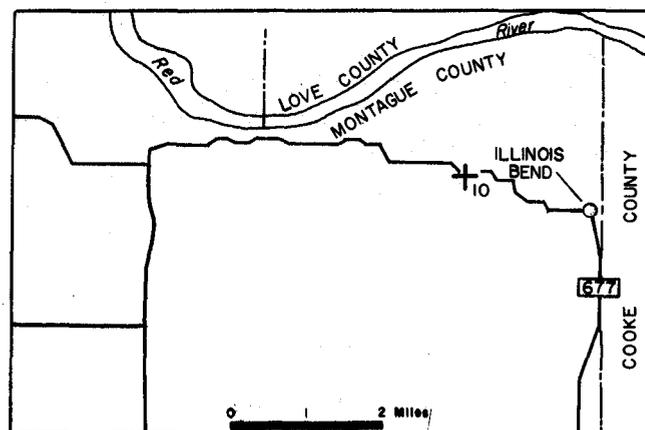
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 3.0            | 3.0                | 3.5            | 3.5                |
| - 20+40                    | 4.2            | 7.2                | 4.9            | 8.4                |
| - 40+60                    | 12.5           | 19.7               | 14.6           | 23.0               |
| - 60+80                    | 12.4           | 32.1               | 14.5           | 37.5               |
| - 80+100                   | 9.6            | 41.7               | 11.2           | 48.7               |
| - 100+140                  | 14.3           | 56.0               | 16.8           | 65.5               |
| - 140+200                  | 29.5           | 85.5               | 34.6           | 100.1              |
| - 200+ pan                 | 14.7           | 100.2              |                |                    |

## LOCATION.

MONTAGUE COUNTY 11. Road cut along gravel road, 2.0 miles east of Bonita. Antlers Formation.

Sample number.-- Montague 11 (64230)

Yield after coning.-- 77.4%

Shape of grains.-- Angular to rounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.45\phi$  (well sorted)

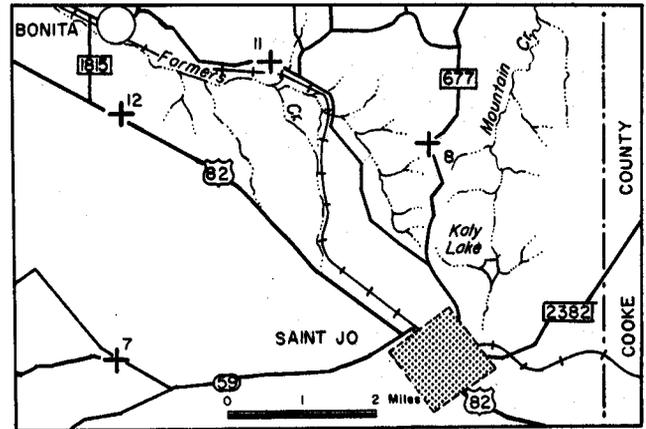
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.06%

Calcium oxide content.-- 0.15%

Alumina content.-- 1.15%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.3            | 0.4                | 0.5            | 0.6                |
| - 40+60                    | 2.0            | 2.4                | 3.6            | 4.2                |
| - 60+80                    | 3.4            | 5.8                | 6.2            | 10.4               |
| - 80+100                   | 5.3            | 11.1               | 9.7            | 20.1               |
| - 100+140                  | 10.8           | 21.9               | 19.6           | 39.7               |
| - 140+200                  | 33.2           | 55.1               | 60.5           | 100.2              |
| - 200+ pan                 | 45.0           | 100.1              |                |                    |

## LOCATION.

MONTAGUE COUNTY 12. Road cut, east side of U. S. Highway 82, 1.0 mile south of Bonita. Antlers Formation.

Sample number.-- Montague 12 (64231)

Yield after coning.-- 94.4%

Shape of grains.-- Subrounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.4\phi$  (well sorted)

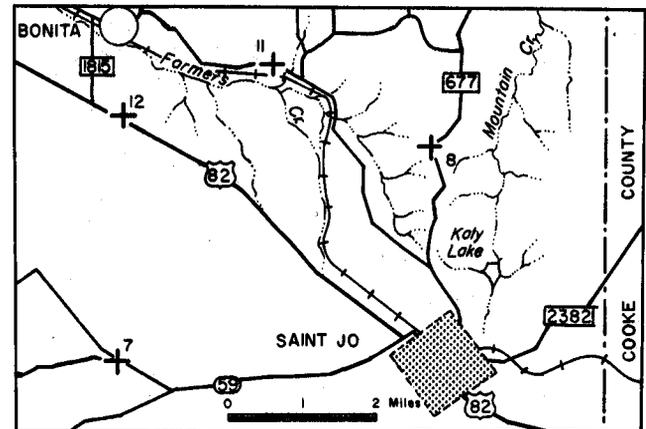
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

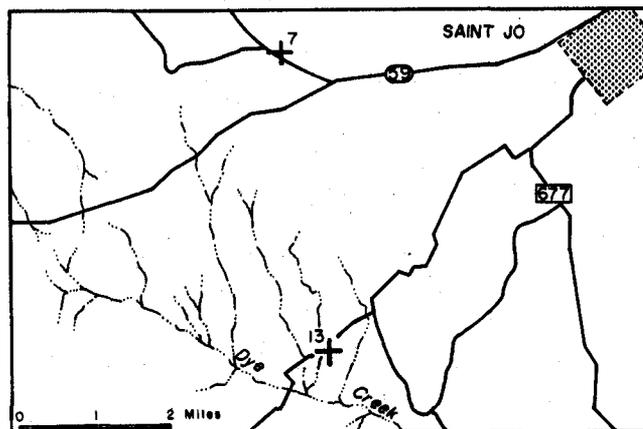
Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.1            | 0.2                | 0.1            | 0.2                |
| - 40+60                    | 0.6            | 0.8                | 0.7            | 0.9                |
| - 60+80                    | 7.9            | 8.7                | 8.7            | 9.6                |
| - 80+100                   | 26.8           | 35.5               | 29.7           | 39.3               |
| - 100+140                  | 31.6           | 67.1               | 35.0           | 74.3               |
| - 140+200                  | 23.0           | 90.1               | 25.5           | 99.8               |
| - 200+ pan                 | 9.6            | 99.7               |                |                    |

LOCATION.

MONTAGUE COUNTY 13. Road cut along gravel road from Saint Jo to Dye Mound, 5.0 miles southwest of Saint Jo. Antlers Formation.



Sample number.-- Montague 13 (64232)

Yield after coning.-- 90.9%

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 3.2 $\phi$  (0.11 mm)

Sorting index.-- 0.25 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

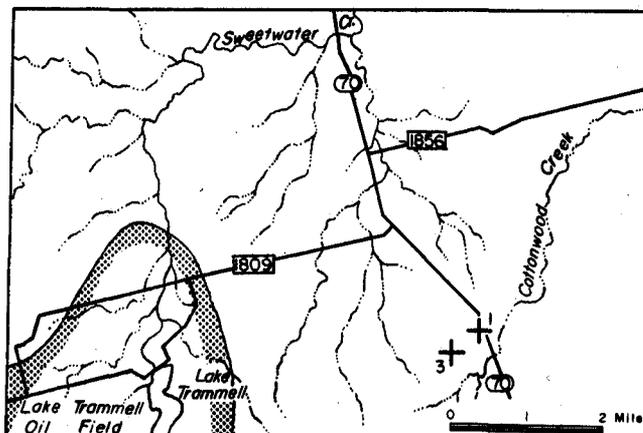
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 0.2            | 0.3                | 0.3            | 0.4                |
| - 60+80                    | 1.1            | 1.4                | 1.6            | 2.0                |
| - 80+100                   | 2.6            | 4.0                | 3.9            | 5.9                |
| - 100+140                  | 9.1            | 13.1               | 13.5           | 19.4               |
| - 140+200                  | 54.5           | 67.6               | 80.6           | 100.0              |
| - 200+ pan                 | 32.3           | 99.9               |                |                    |

LOCATION.

NOLAN COUNTY 1. Road cut along State Highway 70, 2.0 miles southeast of intersection with Farm Road 1809. Antlers Formation.



Sample number.-- Nolan 1 (64234)

Yield after coning.-- 93.7%

Shape of grains.-- Angular to rounded

Graphic mean.-- 1.7 $\phi$  (0.31 mm)

Sorting index.-- 0.7 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.012%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 1.0            | 1.0                | 1.1            | 1.1                |
| - 40+60                    | 37.6           | 38.6               | 40.4           | 41.5               |
| - 60+80                    | 34.6           | 73.2               | 37.2           | 78.7               |
| - 80+100                   | 12.5           | 85.7               | 13.4           | 92.1               |
| - 100+140                  | 3.4            | 89.1               | 3.7            | 95.8               |
| - 140+200                  | 3.8            | 92.9               | 4.1            | 99.9               |
| - 200+ pan                 | 6.9            | 99.8               |                |                    |

## LOCATION.

NOLAN COUNTY 2. Sand pit, north side of gravel road, 2.7 miles southeast of Maryneal. Antlers Formation (upper unit).

Sample number.-- Nolan 2-1 (64241)

Yield after coning.-- 86.1%

Shape of grains.-- Subrounded

Graphic mean.-- 3.0  $\phi$  (0.125 mm)

Sorting index.-- 0.45 $\phi$  (well sorted)

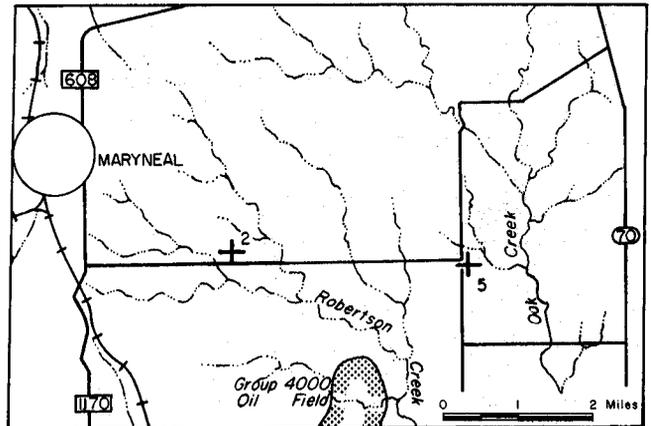
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.3            | 0.3                | 0.5            | 0.5                |
| - 40+60                    | 1.8            | 2.1                | 2.8            | 3.3                |
| - 60+80                    | 4.3            | 6.4                | 6.5            | 9.8                |
| - 80+100                   | 9.9            | 16.3               | 15.1           | 24.9               |
| - 100+140                  | 8.3            | 24.6               | 12.6           | 37.5               |
| - 140+200                  | 41.0           | 65.6               | 62.5           | 100.0              |
| - 200+ pan                 | 34.3           | 99.9               |                |                    |

Sample number.-- Nolan 2-2 (64242)

Yield after coning.-- 94.3%

Shape of grains.-- Subrounded

Graphic mean.-- 2.5 $\phi$  (0.18 mm)

Sorting index.-- 0.8 $\phi$  (moderately sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

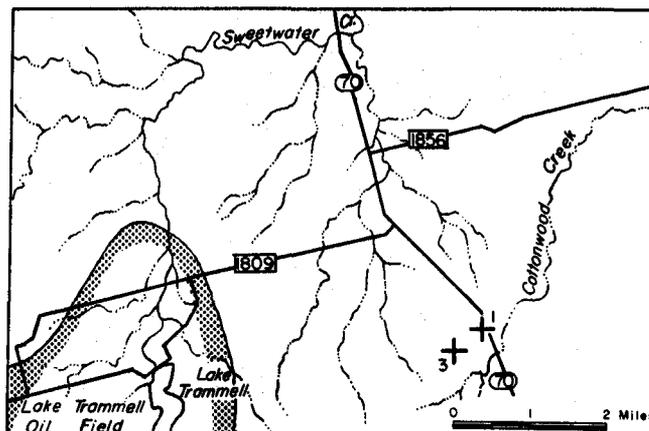
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 1.1            | 1.1                | 1.3            | 1.3                |
| - 40+60                    | 10.5           | 11.6               | 12.7           | 14.0               |
| - 60+80                    | 19.6           | 31.2               | 23.6           | 37.6               |
| - 80+100                   | 20.4           | 51.6               | 24.6           | 62.2               |
| - 100+140                  | 0.3            | 51.9               | 0.4            | 62.6               |
| - 140+200                  | 31.1           | 83.0               | 37.4           | 100.0              |
| - 200+ pan                 | 16.8           | 99.8               |                |                    |

LOCATION.

NOLAN COUNTY 3. Stream bank exposure, west side of State Highway 70, 2.0 miles southeast of intersection with Farm Road 1809. Antlers Formation.



Sample number.--Nolan 3-1 (64235)

Yield after coning.-- 96.3%

Shape of grains.-- Angular to subrounded

Graphic mean.-- 2.0 $\phi$  (0.25 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- 0.016%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 14.0           | 14.1               | 14.6           | 14.7               |
| - 60+80                    | 58.4           | 72.5               | 60.9           | 75.6               |
| - 80+100                   | 18.5           | 91.0               | 19.3           | 94.9               |
| - 100+140                  | 2.6            | 93.6               | 2.7            | 97.6               |
| - 140+200                  | 2.2            | 95.8               | 2.3            | 99.9               |
| - 200+ pan                 | 4.0            | 99.8               |                |                    |

Sample number.--Nolan 3-2 (64236)

Yield after coning.--95.2%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.45 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.7            | 0.8                | 0.7            | 0.8                |
| - 40+60                    | 14.5           | 15.3               | 15.3           | 16.1               |
| - 60+80                    | 43.8           | 59.1               | 46.3           | 62.4               |
| - 80+100                   | 27.5           | 86.6               | 29.1           | 91.5               |
| - 100+140                  | 4.2            | 90.8               | 4.4            | 95.9               |
| - 140+200                  | 3.9            | 94.7               | 4.1            | 100.0              |
| - 200+ pan                 | 5.5            | 100.2              |                |                    |

Sample number.--Nolan 3-3 (64237)

Yield after coning.-- 96.7%

Shape of grains.-- Subrounded

Graphic mean.-- 2.0 $\phi$  (0.25 mm)

Sorting index.-- 0.4 $\phi$ (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 20+40                          | 0.6               | 0.7                   | 0.6               | 0.7                   |
| - 40+60                          | 13.8              | 14.5                  | 14.7              | 15.4                  |
| - 60+80                          | 54.5              | 69.0                  | 57.9              | 73.3                  |
| - 80+100                         | 18.9              | 87.9                  | 20.1              | 93.4                  |
| - 100+140                        | 2.4               | 90.3                  | 2.5               | 95.9                  |
| - 140+200                        | 3.7               | 94.0                  | 3.9               | 99.8                  |
| - 200+ pan                       | 5.8               | 99.8                  |                   |                       |

Sample number.--Nolan 3-4 (64238)

Yield after coning.-- 94.6%

Shape of grains.-- Subangular

Graphic mean.-- 1.8 $\phi$  (0.29 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.021%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 1.2               | 1.2                   | 1.3               | 1.3                   |
| - 20+40                          | 3.5               | 4.7                   | 3.7               | 5.0                   |
| - 40+60                          | 25.9              | 30.6                  | 27.5              | 32.5                  |
| - 60+80                          | 37.0              | 67.6                  | 39.3              | 71.8                  |
| - 80+100                         | 20.5              | 88.1                  | 21.8              | 93.6                  |
| - 100+140                        | 2.8               | 90.9                  | 3.0               | 96.6                  |
| - 140+200                        | 3.2               | 94.1                  | 3.4               | 100.0                 |
| - 200+ pan                       | 5.8               | 99.9                  |                   |                       |

Sample number.--Nolan 3-5 (64239)

Yield after coning.-- 95.8%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.034%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.5               | 0.5                   | 0.5               | 0.5                   |
| - 40+60                          | 7.3               | 7.8                   | 7.7               | 8.2                   |
| - 60+80                          | 16.7              | 24.5                  | 17.7              | 25.9                  |
| - 80+100                         | 34.6              | 59.1                  | 36.8              | 62.7                  |
| - 100+140                        | 15.5              | 74.6                  | 16.4              | 79.1                  |
| - 140+200                        | 19.5              | 94.1                  | 20.7              | 99.8                  |
| - 200+ pan                       | 5.8               | 99.9                  |                   |                       |

LOCATION.

NOLAN COUNTY 4. Stream bank, north side of Plum Creek, immediately south of bridge and gravel road, 7.6 miles west-northwest of Maryneal. Antlers Formation (upper unit).

Sample number.-- Nolan 4 (64240)

Yield after coning.-- 97.8%

Shape of grains.-- Subrounded

Graphic mean.-- 1.8 $\phi$  (0.29 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

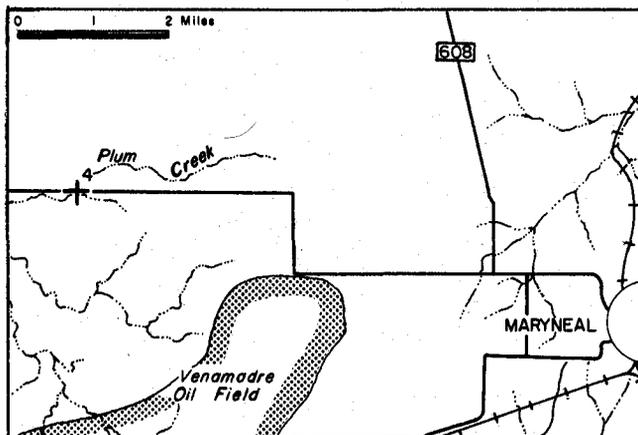
Heavy mineral content.-- 0.015%

Iron oxide content.-- 0.038%

Magnesium oxide content.-- 0.03%

Calcium oxide content.-- 0.05%

Alumina content.-- 0.64%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 1.9            | 1.9                | 2.0            | 2.0                |
| - 40+60                    | 40.0           | 41.9               | 41.0           | 43.0               |
| - 60+80                    | 32.7           | 74.6               | 33.6           | 76.6               |
| - 80+100                   | 17.1           | 91.7               | 17.5           | 94.1               |
| - 100+140                  | 1.1            | 92.8               | 1.1            | 95.2               |
| - 140+200                  | 4.7            | 97.5               | 4.8            | 100.0              |
| - 200+ pan                 | 2.5            | 100.0              |                |                    |

LOCATION.

NOLAN COUNTY 5. Road cut, east side of T intersection of gravel road, 5.7 miles southeast of Maryneal. Antlers Formation (upper unit).

Sample number.-- Nolan 5 (64243)

Yield after coning.-- 98.5%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.3 $\phi$  (0.20 mm)

Sorting index.-- 0.7 $\phi$  (moderately sorted)

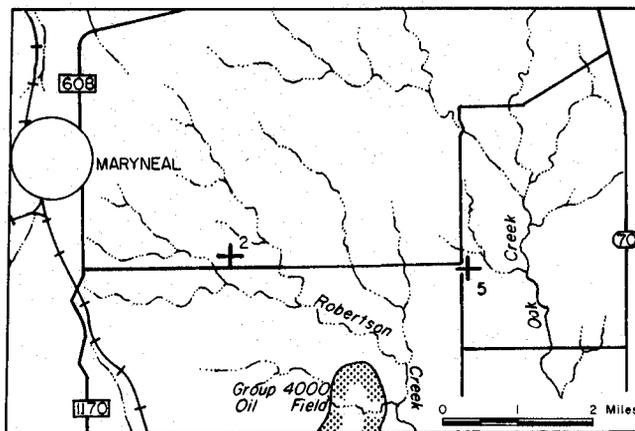
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.4            | 0.4                | 0.4            | 0.4                |
| - 20+40                    | 1.3            | 1.7                | 1.3            | 1.7                |
| - 40+60                    | 15.0           | 17.0               | 15.8           | 17.5               |
| - 60+80                    | 22.5           | 39.5               | 23.2           | 40.7               |
| - 80+100                   | 22.4           | 61.9               | 23.1           | 63.8               |
| - 100+140                  | 19.6           | 81.5               | 20.2           | 84.0               |
| - 140+200                  | 15.3           | 96.8               | 15.8           | 99.8               |
| - 200+ pan                 | 3.0            | 99.8               |                |                    |

## LOCATION.

NOLAN COUNTY 6. Road cut, south side of Farm Road 1170, 1.0 mile west of Hylton. Antlers Formation (upper unit).

Sample number.-- Nolan 6 (64244)

Yield after coning.-- 97.1%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

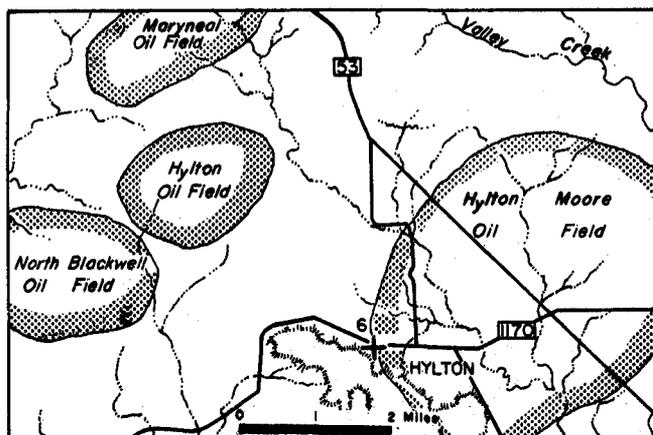
Heavy mineral content.-- 0.034%

Iron oxide content.-- 0.024%

Magnesium oxide content.-- 0.02%

Calcium oxide content.-- 0.03%

Alumina content.-- 0.40%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 40+60                    | 8.1            | 8.3                | 8.5            | 8.7                |
| - 60+80                    | 20.4           | 28.7               | 21.5           | 30.2               |
| - 80+100                   | 32.3           | 61.3               | 34.2           | 64.4               |
| - 100+140                  | 20.8           | 82.1               | 21.9           | 86.3               |
| - 140+200                  | 12.9           | 95.0               | 13.6           | 99.9               |
| - 200+ pan                 | 4.8            | 99.8               |                |                    |

## LOCATION.

PARKER COUNTY 1. Road cut, south side of U. S. Highway 80, 1.5 miles west of Clear Fork crossing, 7.0 miles east of Weatherford courthouse. Paluxy Formation.

Sample number.-- Parker 1 (64285)

Yield after coning.-- 95.8%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.9 $\phi$  (0.13 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

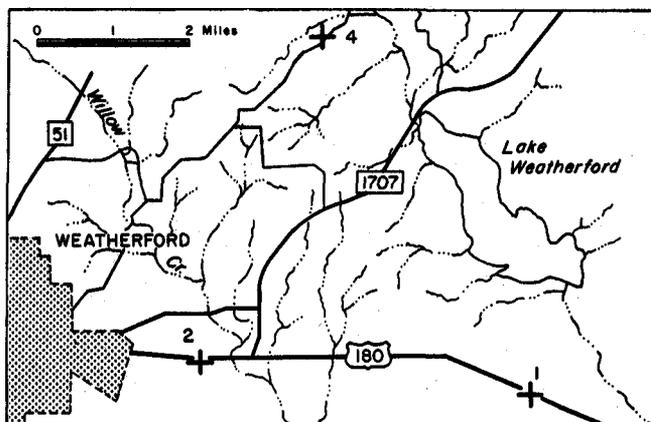
Heavy mineral content.-- 0.040%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

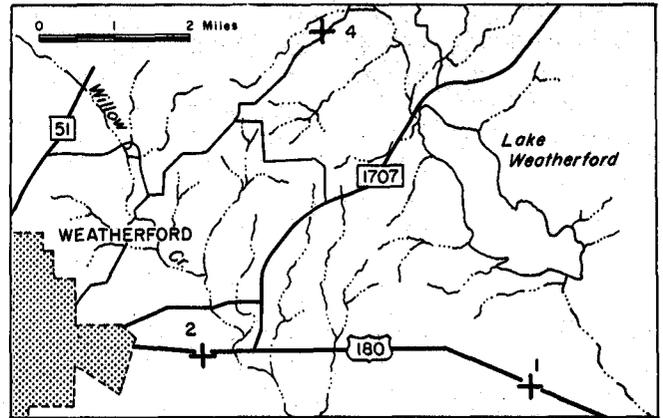
Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.1                |
| - 40+60                    | 0.1            | 0.2                | 0.1            | 0.2                |
| - 60+80                    | 0.5            | 0.7                | 0.7            | 0.9                |
| - 80+100                   | 21.8           | 22.5               | 28.4           | 29.3               |
| - 100+140                  | 15.8           | 38.3               | 20.5           | 49.8               |
| - 140+200                  | 38.6           | 76.9               | 50.1           | 99.9               |
| - 200+ pan                 | 23.0           | 99.9               |                |                    |

LOCATION.

PARKER COUNTY 2. Excavation, east side of Oak Lanes Bowling parking lot, south side of U. S. Highway 80, 2.5 miles east of Weatherford courthouse. Paluxy Formation.



Sample number.-- Parker 2 (64284)

Yield after coning.-- 97.5%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.7 $\phi$  (0.16 mm)

Sorting index.-- 0.4 $\phi$  well sorted

Heavy mineral content.-- 0.024%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.04%

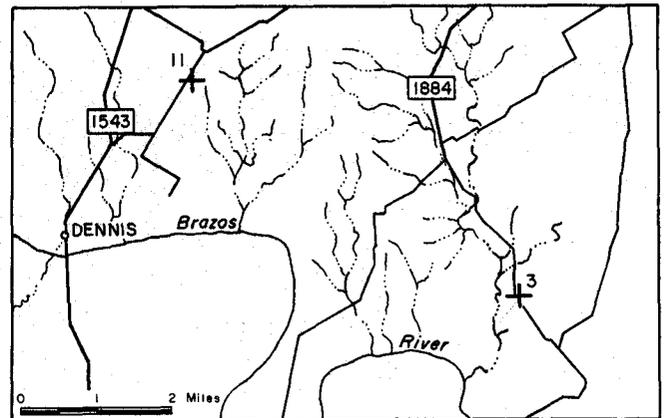
Calcium oxide content.-- 0.03%

Alumina content.-- 0.49%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 40+60                    | 3.5            | 3.7                | 4.2            | 4.4                |
| - 60+80                    | 3.2            | 6.9                | 3.8            | 8.2                |
| - 80+100                   | 41.5           | 48.4               | 49.4           | 57.6               |
| - 100+140                  | 17.2           | 65.6               | 20.5           | 78.1               |
| - 140+200                  | 18.2           | 83.8               | 21.6           | 99.7               |
| - 200+ pan                 | 15.9           | 99.7               |                |                    |

LOCATION.

PARKER COUNTY 3. Stream cut along Farm Road 1884, 1.0 mile northwest of Tin Top. Travis Peak Formation (upper unit).



Sample number.-- Parker 3 (64246)

Yield after coning.-- 97.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.6 $\phi$  moderately well sorted

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 2.2            | 2.3                | 2.4            | 2.5                |
| - 80+100                   | 15.1           | 17.4               | 16.2           | 18.7               |
| - 100+140                  | 28.3           | 45.7               | 30.3           | 49.0               |
| - 140+200                  | 47.2           | 92.9               | 50.5           | 99.5               |
| - 200+ pan                 | 6.7            | 99.6               |                |                    |

## LOCATION.

PARKER COUNTY 4. Road ditch along gravel road, 6.0 miles northeast of Weatherford courthouse, 1.0 mile southwest of Clear Fork of Trinity River crossing. Paluxy Formation.

Sample number.-- Parker 4 (64273)

Yield after coning.-- 94.5%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.5\phi$  (well sorted)

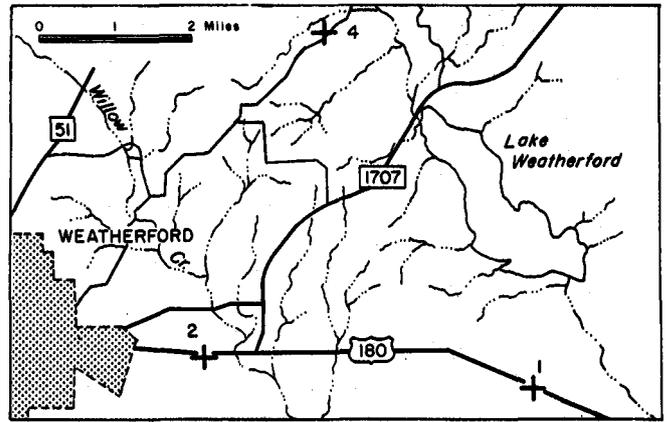
Heavy mineral content.-- 0.041%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.1            | 0.2                | 0.1            | 0.2                |
| - 40+60                    | 1.2            | 1.4                | 1.5            | 1.7                |
| - 60+80                    | 1.1            | 2.5                | 1.3            | 3.0                |
| - 80+100                   | 19.9           | 22.4               | 24.1           | 27.1               |
| - 100+140                  | 22.8           | 45.2               | 27.6           | 54.7               |
| - 140+200                  | 37.4           | 82.6               | 45.3           | 100.0              |
| - 200+ pan                 | 17.5           | 100.1              |                |                    |

## LOCATION.

PARKER COUNTY 5. Bluff, east side of gravel road, 1.5 miles south of Silver Creek church, 6.0 miles south-southwest of Azle. Paluxy Formation.

Sample number.-- Parker 5-1 (64278)

Yield after coning.-- 95.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.3\phi$  (very well sorted)

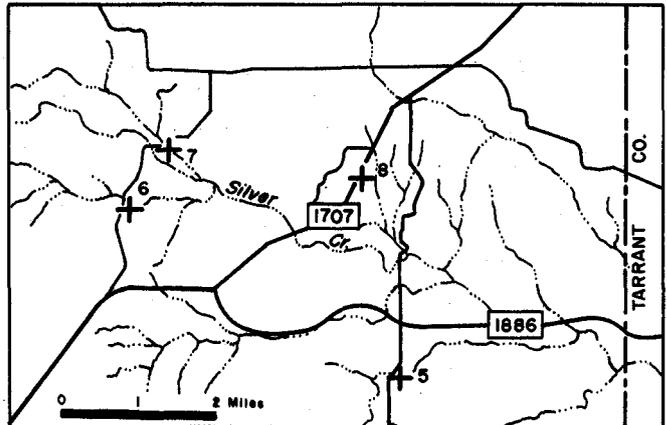
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 1.0            | 1.0                | 1.4            | 1.4                |
| - 20+40                    | 1.4            | 2.4                | 2.0            | 3.4                |
| - 40+60                    | 0.5            | 2.9                | 0.7            | 4.1                |
| - 60+80                    | 0.2            | 3.1                | 0.3            | 4.4                |
| - 80+100                   | 4.0            | 7.1                | 5.6            | 10.0               |
| - 100+140                  | 8.9            | 16.0               | 12.6           | 22.6               |
| - 140+200                  | 54.5           | 70.5               | 77.4           | 100.0              |
| - 200+ pan                 | 29.5           | 100.0              |                |                    |

Sample number.-- Parker 5-2 (64279)

Yield after coning.-- 99.3%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.0 $\phi$  (0.25 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.020%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.01%

Calcium oxide content.-- 0.03%

Alumina content.-- 0.48%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.3            | 0.3                | 0.3            | 0.3                |
| - 40+60                    | 18.8           | 19.1               | 19.7           | 20.0               |
| - 60+80                    | 43.7           | 62.8               | 45.8           | 65.8               |
| - 80+100                   | 27.5           | 90.3               | 28.8           | 94.6               |
| - 100+140                  | 2.3            | 92.6               | 2.4            | 97.0               |
| - 140+200                  | 2.8            | 95.4               | 2.9            | 99.9               |
| - 200+ pan                 | 4.5            | 99.9               |                |                    |

Sample number.-- Parker 5-3 (64280)

Yield after coning.-- 96.1%

Shape of grains.-- Angular to subrounded

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- 0.066%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.5            | 0.6                | 0.6            | 0.7                |
| - 80+100                   | 6.3            | 6.9                | 7.9            | 8.6                |
| - 100+140                  | 15.7           | 22.6               | 19.8           | 28.4               |
| - 140+200                  | 56.6           | 79.2               | 71.5           | 99.9               |
| - 200+ pan                 | 20.7           | 99.9               |                |                    |

## LOCATION.

PARKER COUNTY 6. Stream cut, south bank of branch of Silver Creek, east of gravel road, 7.0 miles west-southwest of Azle. Paluxy Formation.

Sample number.-- Parker 6-1 (64276)

Yield after coning.-- 96.8%

Shape of grains.-- Subangular

Graphic mean.--  $3.0\phi$  (0.125 mm)

Sorting index.--  $0.4\phi$  (well sorted)

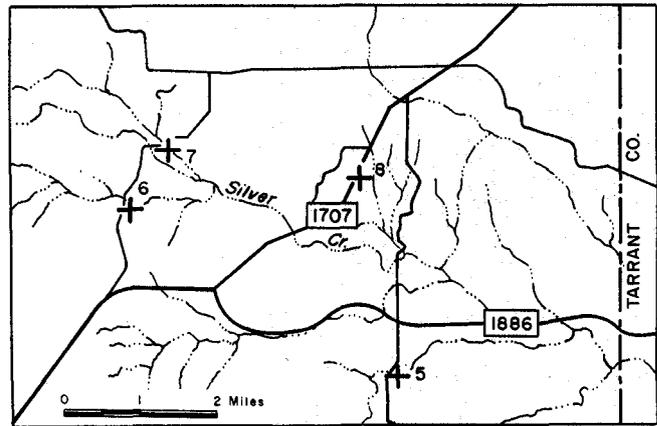
Heavy mineral content.-- 0.024%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.9            | 1.0                | 1.0            | 1.1                |
| - 80+100                   | 14.7           | 15.7               | 16.9           | 18.0               |
| - 100+140                  | 30.6           | 46.3               | 35.2           | 53.2               |
| - 140+200                  | 40.5           | 86.8               | 46.6           | 99.8               |
| - 200+ pan                 | 13.0           | 99.8               |                |                    |

Sample number.-- Parker 6-2 (64277)

Yield after coning.-- 97.9%

Shape of grains.-- Subrounded

Graphic mean.--  $2.6\phi$  (0.17 mm)

Sorting index.--  $0.5\phi$  (well sorted)

Heavy mineral content.-- 0.029%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

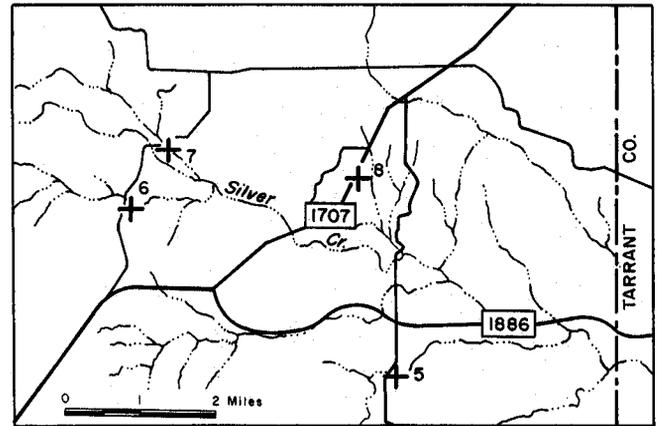
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 3.3            | 3.4                | 3.6            | 3.7                |
| - 60+80                    | 19.6           | 23.0               | 21.1           | 24.8               |
| - 80+100                   | 43.2           | 66.2               | 46.5           | 71.3               |
| - 100+140                  | 9.6            | 75.8               | 10.3           | 81.6               |
| - 140+200                  | 17.0           | 92.8               | 18.3           | 99.9               |
| - 200+ pan                 | 7.1            | 99.9               |                |                    |

LOCATION.

PARKER COUNTY 7. Road cut along gravel road, at crossing of Silver Creek, 7.5 miles west-southwest of Azle. Paluxy Formation.



Sample number.-- Parker 7 (64275)

Yield after coning.-- 89.6%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.7 $\phi$  (0.15 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.01%

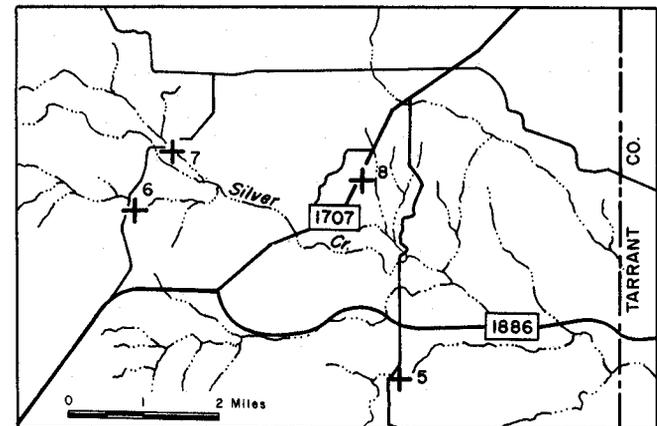
Calcium oxide content.-- 0.04%

Alumina content.-- 0.51%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.7            | 0.7                | 0.9            | 0.9                |
| - 40+60                    | 7.1            | 7.8                | 9.5            | 10.4               |
| - 60+80                    | 9.0            | 16.8               | 12.1           | 22.5               |
| - 80+100                   | 22.7           | 39.5               | 30.6           | 53.1               |
| - 100+140                  | 7.2            | 46.7               | 9.7            | 62.8               |
| - 140+200                  | 27.6           | 74.3               | 37.2           | 100.0              |
| - 200+ pan                 | 25.7           | 100.0              |                |                    |

LOCATION.

PARKER COUNTY 8. Road cut, east side of Farm Road 1707, 4.5 miles southwest of Azle, 1 mile northeast of Silver Creek. Paluxy Formation.



Sample number.-- Parker 8 (64281)

Yield after coning.-- 98.5%

Shape of grains.-- Subrounded

Graphic mean.-- 2.5 $\phi$  (0.18 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.12%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.3            | 0.4                | 0.4            | 0.5                |
| - 40+60                    | 4.6            | 5.0                | 5.5            | 6.0                |
| - 60+80                    | 11.6           | 16.6               | 14.0           | 20.0               |
| - 80+100                   | 37.9           | 54.5               | 45.7           | 65.7               |
| - 100+140                  | 19.0           | 73.5               | 22.9           | 88.6               |
| - 140+200                  | 9.5            | 83.0               | 11.4           | 100.0              |
| - 200+ pan                 | 17.0           | 100.0              |                |                    |

## LOCATION.

PARKER COUNTY 9. Road cut, north side of Farm Road 1542, immediately east of Walnut Creek, at west limits of Reno. Paluxy Formation.

Sample number.-- Parker 9 (64283)

Yield after coning.-- 93.6%

Shape of grains.-- Subrounded

Graphic mean.--  $2.9\phi$  (0.13 mm)

Sorting index.--  $0.4\phi$  (well sorted)

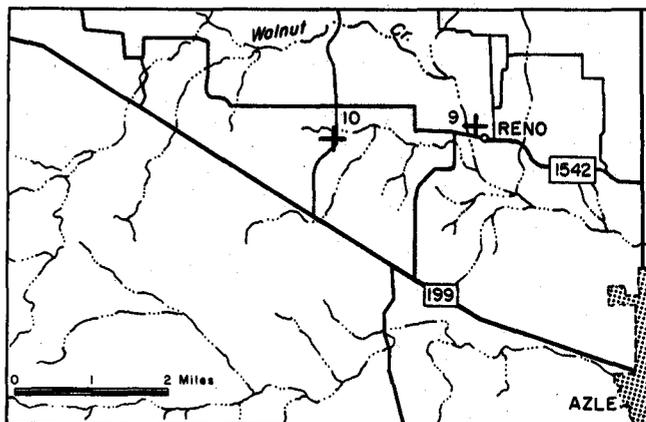
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.--N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 1.3            | 1.4                | 2.0            | 2.1                |
| - 80+100                   | 13.0           | 14.4               | 19.5           | 21.6               |
| - 100+140                  | 15.0           | 29.4               | 22.5           | 44.1               |
| - 140+200                  | 37.6           | 67.0               | 56.2           | 100.3              |
| - 200+ pan                 | 33.1           | 100.0              |                |                    |

## LOCATION.

PARKER COUNTY 10. Road ditch along gravel road, 1.0 mile north of State Highway 199, 2 miles west of Reno. Paluxy Formation.

Sample number.-- Parker 10 (64282)

Yield after coning.-- 92.6%

Shape of grains.-- Rounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

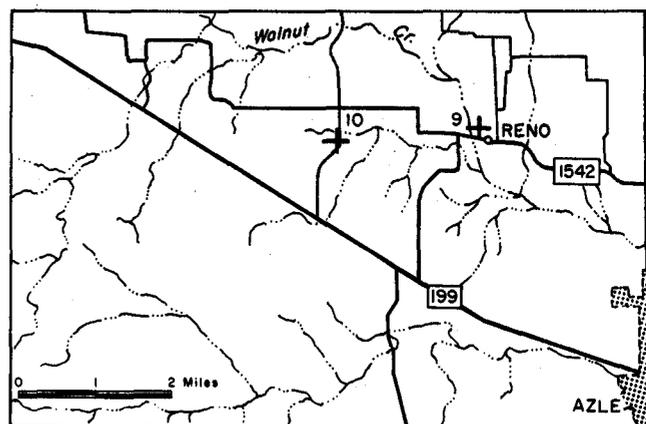
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

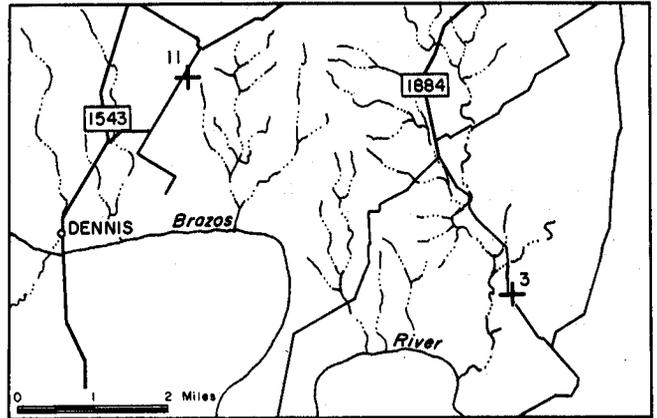
Alumina content.--N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 80+100                   | 1.5            | 1.6                | 2.2            | 2.3                |
| - 100+140                  | 7.0            | 8.6                | 10.6           | 12.9               |
| - 140+200                  | 57.5           | 66.1               | 87.1           | 100.0              |
| - 200+ pan                 | 34.0           | 100.1              |                |                    |

LOCATION.

PARKER COUNTY 11. Road cut and road ditch along Weatherford-Dennis blacktop road, 3.0 miles northeast of Dennis. Twin Mountains Formation.



Sample number.-- Parker 11 (64247)

Yield after coning.-- 99.3%

Shape of grains.-- Subrounded

Graphic mean.-- 2.9 $\phi$  (0.13 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

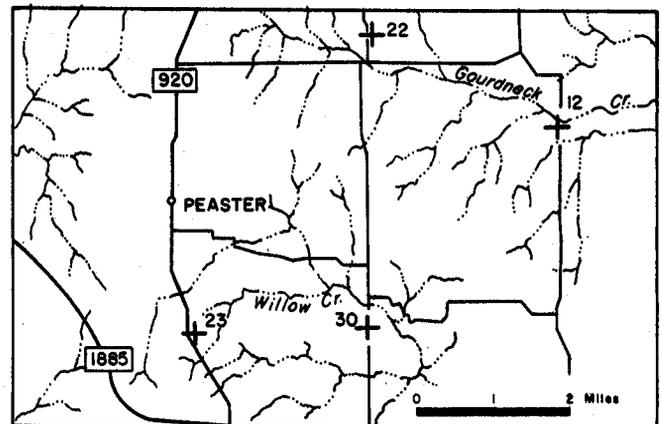
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.8            | 0.9                | 0.9            | 1.0                |
| - 80+100                   | 21.2           | 22.1               | 23.9           | 24.9               |
| - 100+140                  | 31.4           | 53.5               | 35.3           | 60.2               |
| - 140+200                  | 35.3           | 88.8               | 39.8           | 100.0              |
| - 200+ pan                 | 11.2           | 100.0              |                |                    |

LOCATION.

PARKER COUNTY 12. Road ditch along gravel road between Missionary Baptist Church and Northside Consolidated School, at crossing of Gourdeck Creek, 5.0 miles east-northeast of Peaster. Paluxy Formation.



Sample number.-- Parker 12-1 (64271)

Yield after coning.-- 92.0%

Shape of grains.-- Subrounded to rounded

Graphic mean.-- 3.2 $\phi$  (0.11 mm)

Sorting index.-- 0.2 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.1            | 0.1                |
| - 60+80                    | 0.1            | 0.1                | 0.4            | 0.5                |
| - 80+100                   | 1.9            | 2.0                | 5.6            | 6.1                |
| - 100+140                  | 1.9            | 3.9                | 5.6            | 11.7               |
| - 140+200                  | 29.4           | 33.3               | 88.1           | 99.8               |
| - 200+ pan                 | 66.7           | 100.0              |                |                    |

Sample number.-- Parker 12-2 (64272)

Yield after coning.-- 95.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.5\phi$  (well sorted)

Heavy mineral content.-- 0.031%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

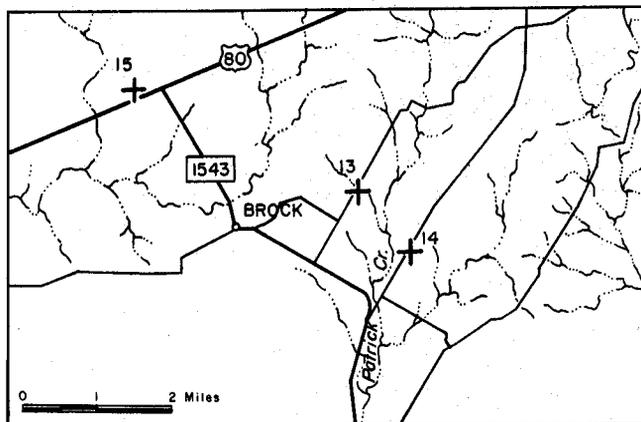
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 40+60                          | 3.2               | 3.2                   | 3.6               | 3.6                   |
| - 60+80                          | 5.0               | 8.2                   | 5.7               | 9.3                   |
| - 80+100                         | 36.6              | 44.8                  | 41.8              | 51.1                  |
| - 100+140                        | 10.4              | 55.2                  | 11.8              | 62.9                  |
| - 140+200                        | 32.6              | 87.8                  | 37.1              | 100.0                 |
| - 200+ pan                       | 12.1              | 99.9                  |                   |                       |

#### LOCATION.

PARKER COUNTY 13. Stream cut along gravel road, 1.8 miles northeast of Brock. Twin Mountains Formation.



Sample number.-- Parker 13 (64248)

Yield after coning.-- 83.4%

Shape of grains.-- Subangular

Graphic mean.--  $2.9\phi$  (0.13 mm)

Sorting index.--  $0.36\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.12%

Magnesium oxide content.-- N. D.

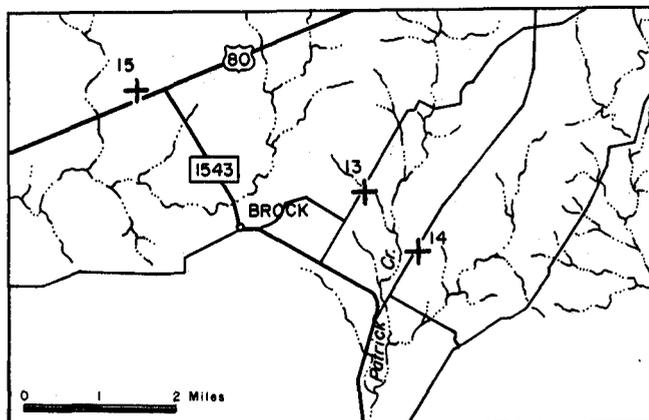
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 40+60                          | 0.2               | 0.2                   | 0.3               | 0.3                   |
| - 60+80                          | 2.0               | 2.2                   | 3.6               | 3.9                   |
| - 80+100                         | 8.7               | 10.9                  | 16.1              | 20.0                  |
| - 100+140                        | 15.1              | 26.0                  | 27.8              | 47.8                  |
| - 140+200                        | 28.3              | 54.3                  | 52.2              | 100.0                 |
| - 200+ pan                       | 45.7              | 100.0                 |                   |                       |

LOCATION.

PARKER COUNTY 14. Road cut along blacktop road, 2.3 miles east of Brock, 5 miles south of U. S. Highway 80. Twin Mountains Formation.



Sample number.-- Parker 14 (64249)

Yield after coning.-- 91.7%

Shape of grains.-- Subrounded

Graphic mean.-- 3.2φ (0.11 mm)

Sorting index.-- 0.2φ (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.16%

Magnesium oxide content.-- N. D.

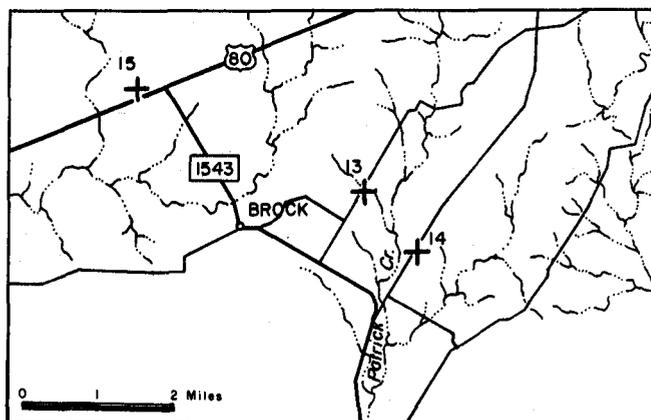
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.1            | 0.1                |
| - 60+80                    | 0.1            | 0.1                | 0.3            | 0.4                |
| - 80+100                   | 0.5            | 0.6                | 1.0            | 1.4                |
| - 100+140                  | 3.5            | 4.1                | 7.5            | 8.9                |
| - 140+200                  | 42.4           | 46.5               | 91.2           | 100.1              |
| - 200+ pan                 | 53.5           | 100.0              |                |                    |

LOCATION.

PARKER COUNTY 15. Road cut along U. S. Highway 80, 200 yards west of intersection with Farm Road 1543. Twin Mountains Formation (lower unit).



Sample number.-- Parker 15 (64250)

Yield after coning.-- 92.6%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 1.2φ (0.44 mm)

Sorting index.-- 1.1φ (poorly sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 1.0            | 1.0                | 1.1            | 1.1                |
| - 20+40                    | 36.6           | 37.6               | 41.3           | 42.4               |
| - 40+60                    | 31.0           | 68.6               | 35.0           | 77.4               |
| - 60+80                    | 4.3            | 72.9               | 4.9            | 82.3               |
| - 80+100                   | 9.8            | 82.7               | 11.0           | 93.3               |
| - 100+140                  | 2.9            | 85.6               | 3.3            | 96.6               |
| - 140+200                  | 3.0            | 88.6               | 3.4            | 100.0              |
| - 200+ pan                 | 11.3           | 99.9               |                |                    |

## LOCATION.

PARKER COUNTY 16. Road ditch along gravel road, 4 miles south-southeast of Agnes, 100 yards south of Union Missionary Baptist Church. Paluxy Formation.

Sample number.-- Parker 16 (64270)

Yield after coning.-- 93.4%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.8  $\phi$  (0.14 mm)

Sorting index.-- 0.4  $\phi$  (well sorted)

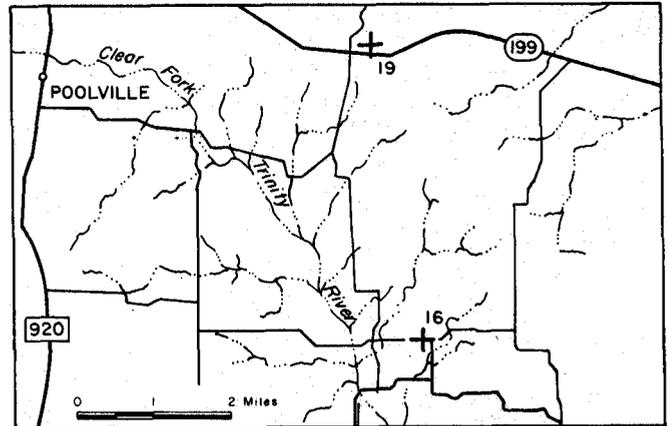
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.13%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 1.0            | 1.0                | 1.2            | 1.2                |
| - 60+80                    | 0.9            | 1.9                | 1.1            | 2.3                |
| - 80+100                   | 42.9           | 44.8               | 51.0           | 53.3               |
| - 100+140                  | 7.7            | 52.5               | 9.1            | 62.4               |
| - 140+200                  | 31.6           | 84.1               | 37.6           | 100.0              |
| - 200+ pan                 | 15.8           | 99.9               |                |                    |

## LOCATION.

PARKER COUNTY 17. Road cut along blacktop road, 1.0 mile west of Greenwood Church, 5.0 miles west of Weatherford courthouse. Paluxy Formation.

Sample number.-- Parker 17 (64251)

Yield after coning.-- 90.9%

Shape of grains.-- Subrounded

Graphic mean.-- 3.1  $\phi$  (0.12 mm)

Sorting index.-- 0.4  $\phi$  (well sorted)

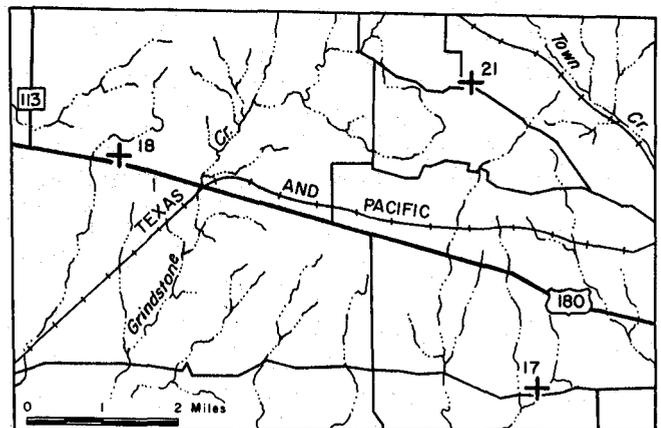
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.10%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

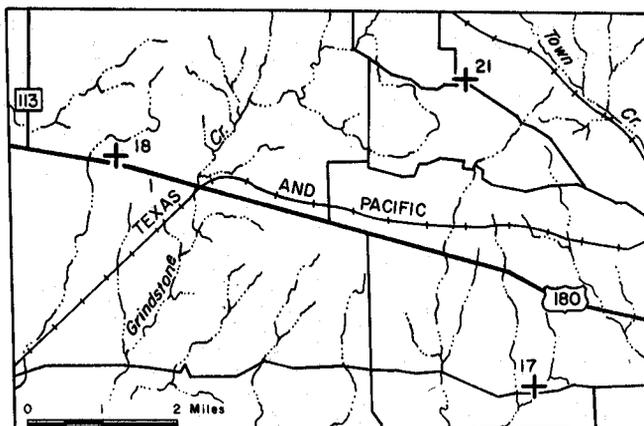
Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.1            | 0.2                | 0.1            | 0.2                |
| - 80+100                   | 4.6            | 4.8                | 6.3            | 6.5                |
| - 100+140                  | 18.6           | 23.4               | 25.5           | 32.0               |
| - 140+200                  | 49.5           | 72.9               | 68.0           | 100.0              |
| - 200+ pan                 | 27.1           | 100.0              |                |                    |

LOCATION.

PARKER COUNTY 18. Road cut along U. S. Highway 80, 2.0 miles east of Cool. Twin Mountains Formation (upper unit).



Sample number.-- Parker 18-1 (64252)

Yield after coning.-- 83.8%

Shape of grains.-- Subrounded

Graphic mean.-- 2.9 $\phi$  (0.13 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 0.3            | 0.4                | 0.4            | 0.5                |
| - 60+80                    | 1.0            | 1.4                | 1.4            | 1.9                |
| - 80+100                   | 24.3           | 25.7               | 33.3           | 35.2               |
| - 100+140                  | 20.2           | 45.9               | 27.6           | 62.8               |
| - 140+200                  | 27.2           | 73.1               | 37.2           | 100.0              |
| - 200+ pan                 | 26.9           | 100.0              |                |                    |

Sample number.-- Parker 18-2 (64253)

Yield after coning.-- 95.1%

Shape of grains.-- Subrounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

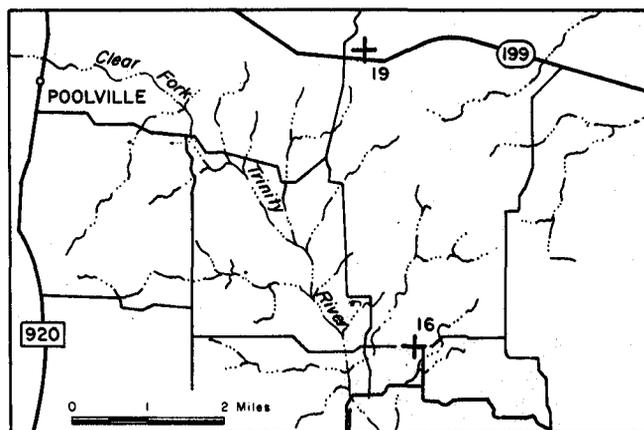
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.4            | 0.4                | 0.4            | 0.4                |
| - 20+40                    | 0.0            | 0.4                | 0.0            | 0.4                |
| - 40+60                    | 0.2            | 0.6                | 0.2            | 0.6                |
| - 60+80                    | 1.5            | 2.1                | 1.6            | 2.2                |
| - 80+100                   | 37.4           | 39.5               | 40.7           | 42.9               |
| - 100+140                  | 29.3           | 68.8               | 31.8           | 74.7               |
| - 140+200                  | 23.1           | 91.9               | 25.1           | 99.8               |
| - 200+ pan                 | 7.8            | 99.7               |                |                    |

## LOCATION.

PARKER COUNTY 19. Road cut along State Highway 199, at the east limits of Agnes. Paluxy Formation.



Sample number.-- Parker 19 (64274)

Yield after coning.-- 95.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.7 $\phi$  (0.15 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.050%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

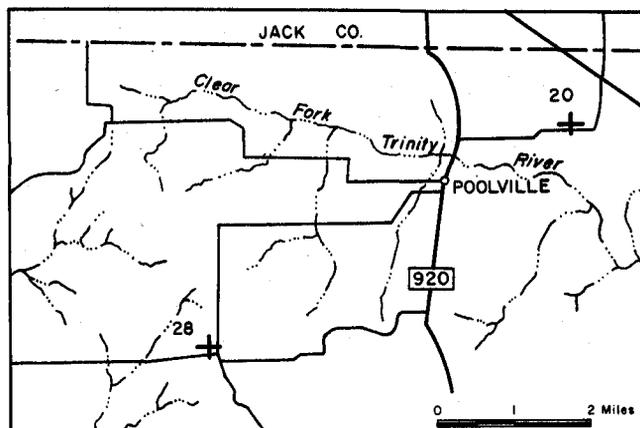
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 3.0            | 3.0                | 3.6            | 3.6                |
| - 20+40                    | 1.5            | 4.5                | 1.8            | 5.4                |
| - 40+60                    | 3.2            | 7.7                | 3.8            | 9.2                |
| - 60+80                    | 5.7            | 13.4               | 6.8            | 16.0               |
| - 80+100                   | 29.4           | 42.8               | 35.2           | 51.2               |
| - 100+140                  | 20.9           | 63.7               | 25.0           | 76.2               |
| - 140+200                  | 19.8           | 83.5               | 23.7           | 99.9               |
| - 200+ pan                 | 16.5           | 100.0              |                |                    |

## LOCATION.

PARKER COUNTY 20. Road ditch along gravel road from Poolville to Agnes, 1.8 miles northeast of Poolville. Paluxy Formation.



Sample number.-- Parker 20 (64269)

Yield after coning.-- 96.6%

Shape of grains.-- Subrounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

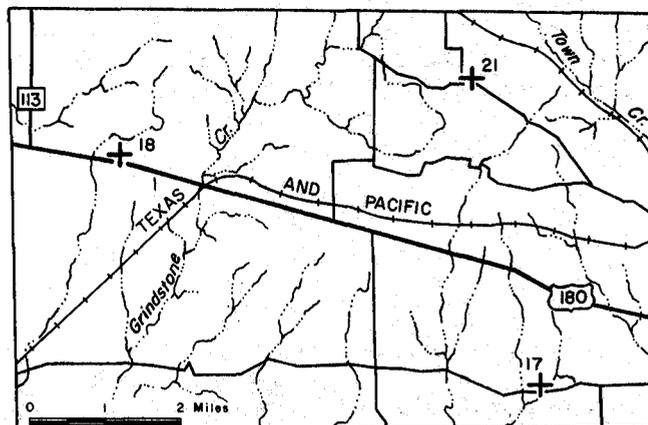
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 60+80                    | 0.7            | 0.9                | 0.8            | 1.0                |
| - 80+100                   | 50.1           | 51.0               | 53.6           | 54.6               |
| - 100+140                  | 9.4            | 60.4               | 10.1           | 64.7               |
| - 140+200                  | 32.8           | 93.2               | 35.2           | 99.9               |
| - 200+ pan                 | 6.6            | 99.8               |                |                    |

LOCATION.

PARKER COUNTY 21. Road cut along Weatherford-Garner road, 6.5 miles northwest of Weatherford courthouse. Paluxy Formation.



Sample number.-- Parker 21-1 (64255)

Yield after coning.-- 95.2%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.7 $\phi$  (moderately sorted)

Heavy mineral content.-- 0.028%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 15.0           | 15.1               | 16.6           | 16.7               |
| - 60+80                    | 9.0            | 24.1               | 9.9            | 26.6               |
| - 80+100                   | 34.9           | 59.0               | 38.5           | 65.1               |
| - 100+140                  | 7.8            | 66.8               | 8.6            | 73.7               |
| - 140+200                  | 23.9           | 90.7               | 26.3           | 100.0              |
| - 200+ pan                 | 9.3            | 100.0              |                |                    |

Sample number.-- Parker 21-2 (64256)

Yield after coning.-- 97.0%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.0 $\phi$  (0.25 mm)

Sorting index.-- 0.7 $\phi$  (moderately sorted)

Heavy mineral content.-- 0.025%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

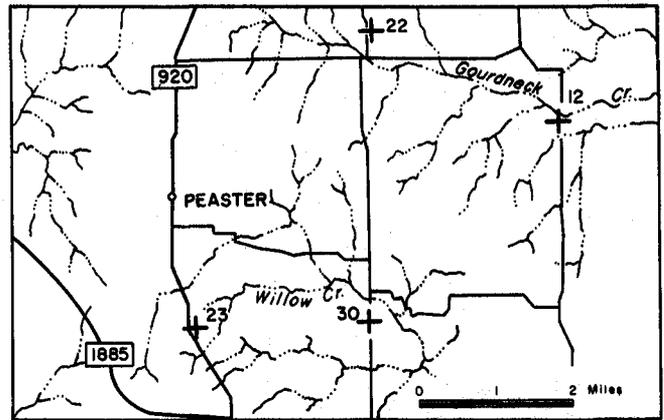
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.8            | 0.8                | 0.8            | 0.8                |
| - 40+60                    | 20.8           | 21.6               | 21.7           | 22.5               |
| - 60+80                    | 5.0            | 26.6               | 5.2            | 27.7               |
| - 80+100                   | 49.0           | 75.6               | 51.0           | 78.7               |
| - 100+140                  | 12.0           | 87.6               | 12.5           | 91.2               |
| - 140+200                  | 8.2            | 95.8               | 8.6            | 99.8               |
| - 200+ pan                 | 4.0            | 99.8               |                |                    |

## LOCATION.

PARKER COUNTY 22. Road ditch along gravel road from Zion Hill to Agnes, 5.4 miles north of Zion Hill. Paluxy Formation.



Sample number.-- Parker 22 (64268)

Yield after coning.-- 98.6%

Shape of grains.-- Subrounded

Graphic mean.--  $2.7\phi$  (0.16 mm)

Sorting index.--  $0.4\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

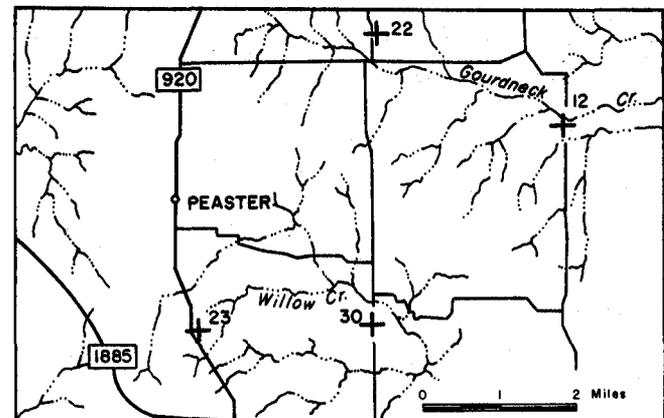
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.7            | 0.8                | 0.7            | 0.8                |
| - 40+60                    | 6.8            | 7.6                | 7.1            | 7.9                |
| - 60+80                    | 3.7            | 11.3               | 3.9            | 11.8               |
| - 80+100                   | 35.8           | 47.1               | 34.4           | 49.2               |
| - 100+140                  | 27.0           | 74.1               | 28.2           | 77.4               |
| - 140+200                  | 21.5           | 95.6               | 22.5           | 99.9               |
| - 200+ pan                 | 4.4            | 100.0              |                |                    |

## LOCATION.

PARKER COUNTY 23. Road cut along Farm Road 920, 1.7 miles south of Peaster. Paluxy Formation.



Sample number.-- Parker 23 (64257)

Yield after coning.-- 96.6%

Shape of grains.-- Subround to rounded

Graphic mean.--  $2.6\phi$  (0.17 mm)

Sorting index.--  $0.6\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.3            | 0.3                |
| - 40+60                    | 12.7           | 12.9               | 15.4           | 15.7               |
| - 60+80                    | 1.9            | 14.8               | 2.3            | 18.0               |
| - 80+100                   | 23.1           | 37.9               | 28.1           | 46.1               |
| - 100+140                  | 11.5           | 49.4               | 14.0           | 60.1               |
| - 140+200                  | 32.9           | 82.3               | 40.0           | 100.1              |
| - 200+ pan                 | 17.8           | 100.1              |                |                    |

LOCATION.

PARKER COUNTY 24. Stream cut along gravel road from Peaster to Authon, 1.3 miles west of Peaster, 1.0 mile east of Farm Road 1885. Paluxy Formation.

Sample number.-- Parker 24 (64258)

Yield after coning.-- 91.5%

Shape of grains.-- Subrounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

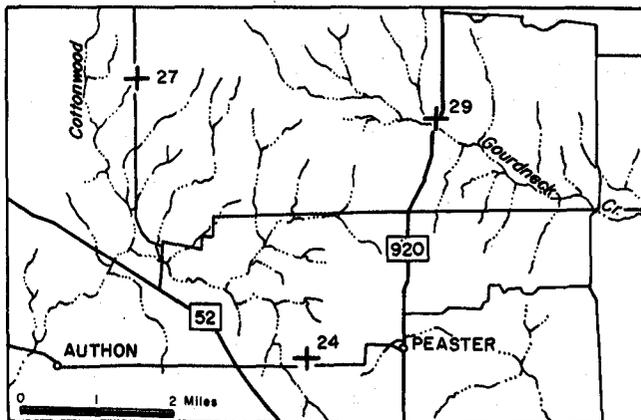
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.7            | 0.7                | 1.4            | 1.4                |
| - 60+80                    | 0.2            | 0.9                | 0.5            | 1.9                |
| - 80+100                   | 4.6            | 5.5                | 9.4            | 11.3               |
| - 100+140                  | 3.1            | 8.6                | 6.2            | 17.5               |
| - 140+200                  | 40.8           | 49.4               | 82.5           | 100.0              |
| - 200+ pan                 | 50.5           | 99.9               |                |                    |

LOCATION.

PARKER COUNTY 25. Road cut along secondary road, 3.0 miles northeast of Whitt. Paluxy Formation.

Sample number.-- Parker 25 (64259)

Yield after coning.-- 93.6%

Shape of grains.-- Subangular to subrounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

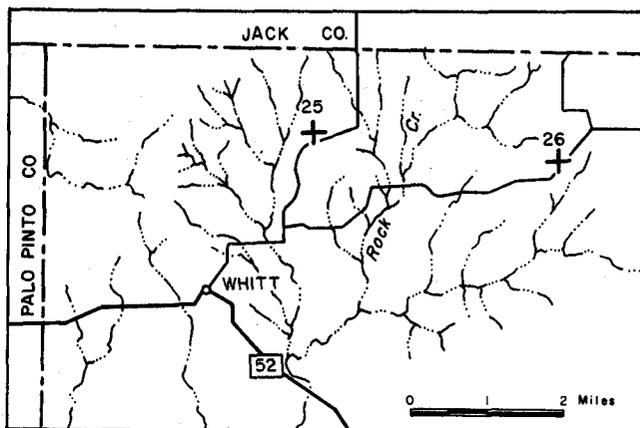
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.2            | 0.2                |
| - 20+40                    | 0.0            | 0.1                | 0.0            | 0.2                |
| - 40+60                    | 0.0            | 0.1                | 0.0            | 0.2                |
| - 60+80                    | 0.0            | 0.1                | 0.1            | 0.3                |
| - 80+100                   | 0.8            | 0.9                | 2.1            | 2.4                |
| - 100+140                  | 3.8            | 4.7                | 9.6            | 12.0               |
| - 140+200                  | 35.1           | 39.8               | 88.0           | 100.0              |
| - 200+ pan                 | 60.1           | 99.9               |                |                    |

## LOCATION

PARKER COUNTY 26. Road ditch along gravel road from Whitt to Poolville, 5.0 miles west of Poolville, 6.0 miles west of Whitt. Paluxy Formation.

Sample number.-- Parker 26 (64260)

Yield after coning.-- 97.1%

Shape of grains.-- Rounded

Graphic mean.-- 3.2 $\phi$  (0.11 mm)

Sorting index.-- 0.2 $\phi$  (very well sorted)

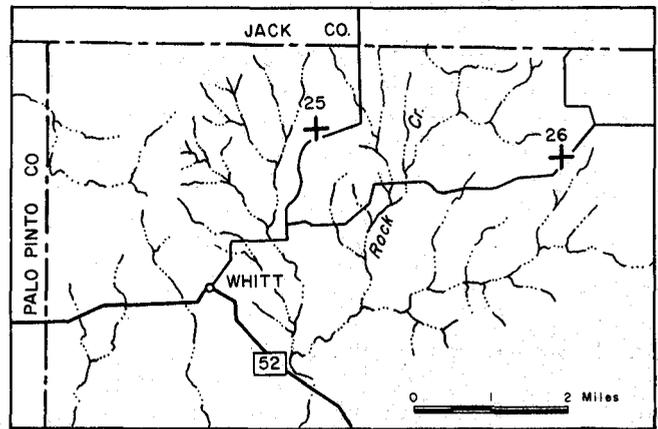
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.2            | 0.2                | 0.3            | 0.3                |
| - 60+80                    | 0.2            | 0.4                | 0.3            | 0.6                |
| - 80+100                   | 0.9            | 1.3                | 1.9            | 2.5                |
| - 100+140                  | 1.6            | 2.9                | 3.2            | 5.7                |
| - 140+200                  | 47.4           | 50.3               | 94.4           | 100.1              |
| - 200+ pan                 | 49.7           | 100.0              |                |                    |

## LOCATION.

PARKER COUNTY 27. Road ditch along gravel road, 5.0 miles southwest of Poolville. Paluxy Formation.

Sample number.-- Parker 27 (64261)

Yield after coning.-- 97.4%

Shape of grains.-- Rounded

Graphic mean.-- 3.1 $\phi$  (0.12 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

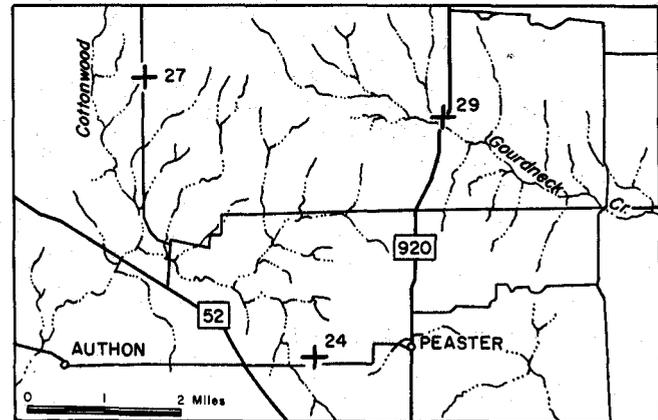
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.15%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

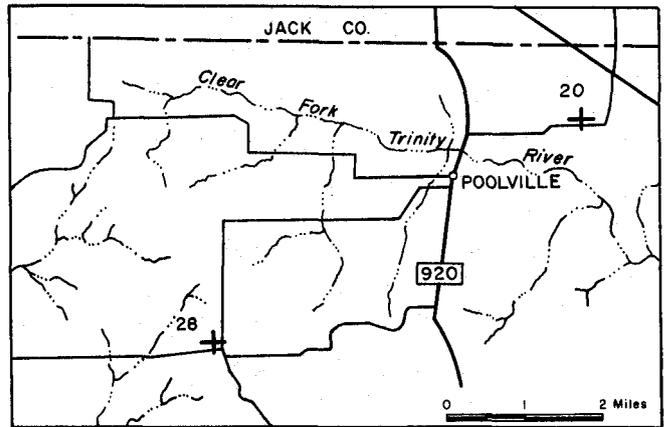
Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.2            | 0.2                | 0.3            | 0.3                |
| - 60+80                    | 0.2            | 0.4                | 0.3            | 0.6                |
| - 80+100                   | 9.5            | 9.9                | 14.2           | 14.8               |
| - 100+140                  | 3.4            | 13.3               | 5.1            | 19.9               |
| - 140+200                  | 53.3           | 66.6               | 80.1           | 100.0              |
| - 200+ pan                 | 33.4           | 100.0              |                |                    |

LOCATION.

PARKER COUNTY 28. Bluff and road ditch, north side of gravel road, 3.5 miles southwest of Poolville. Paluxy Formation.



Sample number.-- Parker 28-1 (64262)

Yield after coning.-- 97.1%

Shape of grains.-- Subrounded

Graphic mean.-- 3.2 $\phi$  (0.11 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 80+100                   | 4.1            | 4.2                | 5.7            | 5.8                |
| - 100+140                  | 9.6            | 13.8               | 13.4           | 19.2               |
| - 140+200                  | 57.7           | 71.5               | 80.6           | 99.8               |
| - 200+ pan                 | 28.3           | 99.8               |                |                    |

Sample number.-- Parker 28-2 (64263)

Yield after coning.-- 97.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- 0.062%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.03%

Calcium oxide content.-- 0.02%

Alumina content.-- 0.47%

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 20+40                    | 0.3            | 0.5                | 0.3            | 0.5                |
| - 40+60                    | 8.9            | 9.4                | 9.4            | 9.9                |
| - 60+80                    | 15.4           | 24.8               | 16.3           | 26.2               |
| - 80+100                   | 35.4           | 60.2               | 37.4           | 63.6               |
| - 100+140                  | 16.8           | 77.0               | 17.7           | 81.3               |
| - 140+200                  | 17.5           | 94.5               | 18.5           | 99.8               |
| - 200+ pan                 | 5.2            | 99.7               |                |                    |

Sample number.-- Parker 28-3 (64264)

Yield after coning.-- 92.2%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- 0.032%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

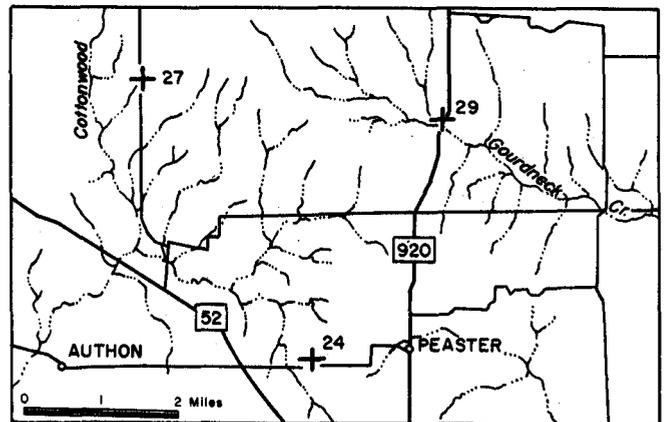
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.5            | 0.5                | 0.6            | 0.6                |
| - 60+80                    | 2.4            | 2.9                | 2.9            | 3.5                |
| - 80+100                   | 32.0           | 34.9               | 38.8           | 42.3               |
| - 100+140                  | 21.8           | 56.7               | 26.4           | 68.7               |
| - 140+200                  | 25.9           | 82.6               | 31.4           | 100.1              |
| - 200+ pan                 | 17.5           | 100.1              |                |                    |

LOCATION.

PARKER COUNTY 29. Road cut along Farm Road 920, 4.0 miles south of Poolville. Paluxy Formation.



Sample number.-- Parker 29 (64265)

Yield after coning.-- 97.1%

Shape of grains.-- Subrounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

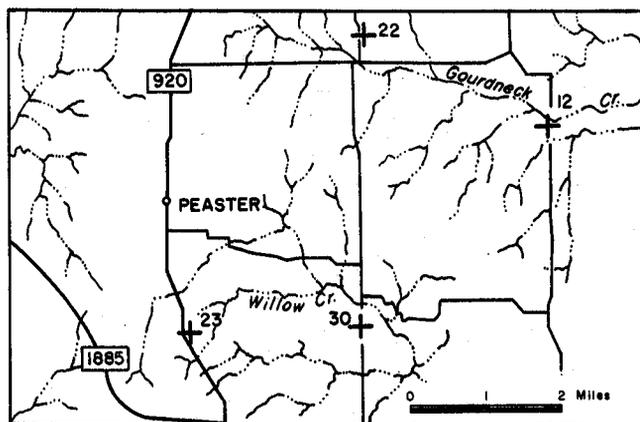
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.6            | 0.6                | 0.7            | 0.7                |
| - 80+100                   | 16.9           | 17.5               | 19.3           | 20.0               |
| - 100+140                  | 27.6           | 45.1               | 31.5           | 51.5               |
| - 140+200                  | 42.6           | 87.7               | 48.6           | 100.1              |
| - 200+ pan                 | 12.3           | 100.0              |                |                    |

LOCATION.

PARKER COUNTY 30. Road ditch along gravel road from Zion Hill to Agnes, 1.5 miles north of Zion Hill. Paluxy Formation.



Sample number.-- Parker 30 (64266)

Yield after coning.-- 97.9%

Shape of grains.-- Subround

Graphic mean.-- 3.0φ (0.125 mm)

Sorting index.-- 0.35φ (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

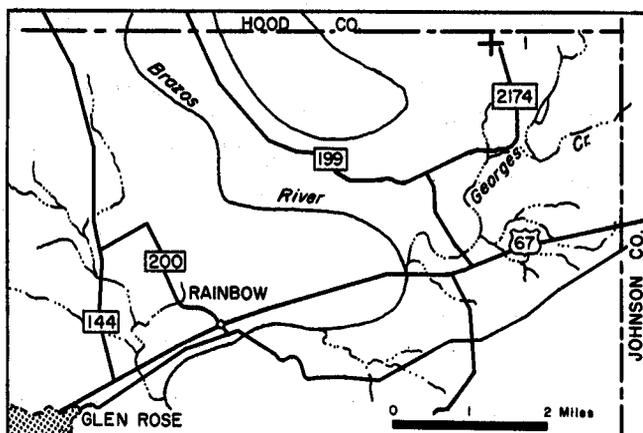
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.3            | 0.3                | 0.3            | 0.3                |
| - 80+100                   | 8.4            | 8.7                | 9.3            | 9.6                |
| - 100+140                  | 27.4           | 36.1               | 30.2           | 39.8               |
| - 140+200                  | 54.6           | 90.7               | 60.2           | 100.0              |
| - 200+ pan                 | 9.1            | 99.8               |                |                    |

LOCATION.

SOMERVELL COUNTY 1. Road cut, west side of Farm Road 2174, 0.2 mile south of Hood County line, 8.0 miles northeast of Glen Rose. Paluxy Formation.



Sample number.-- Somervell 1 (64286)

Yield after coning.-- 92.0%

Shape of grains.-- Rounded

Graphic mean.-- 3.3φ (0.10 mm)

Sorting index.-- 0.2φ (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N. D.

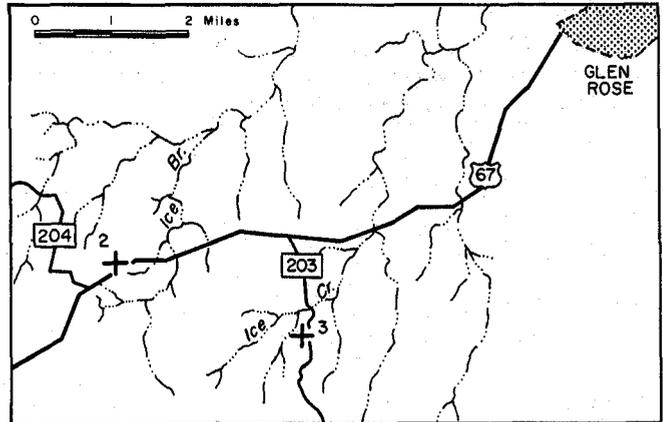
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 80+100                   | 0.3            | 0.3                | 0.5            | 0.5                |
| - 100+140                  | 2.7            | 3.0                | 4.3            | 4.8                |
| - 140+200                  | 59.8           | 62.8               | 95.0           | 99.8               |
| - 200+ pan                 | 37.1           | 99.9               |                |                    |

LOCATION.

SOMERVELL COUNTY 2. Road cut, north side of U. S. Highway 67, 7.0 miles southwest of Glen Rose. Paluxy Formation.



Sample number.--Somervell 2 (64287)

Yield after coning.-- 94.7%

Shape of grains.-- Rounded

Graphic mean.-- 3.2 $\phi$  (0.11 mm)

Sorting index.-- 0.2 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

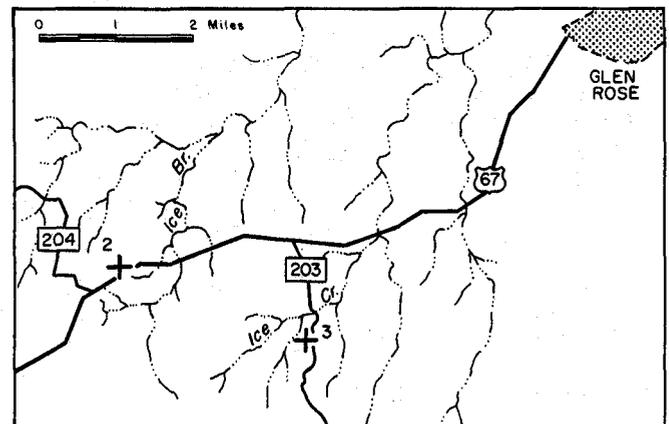
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 80+100                   | 0.8            | 0.8                | 1.5            | 1.5                |
| - 100+140                  | 6.6            | 7.4                | 12.7           | 14.2               |
| - 140+200                  | 44.4           | 51.8               | 86.0           | 100.2              |
| - 200+ pan                 | 48.4           | 100.2              |                |                    |

LOCATION.

SOMERVELL COUNTY 3. Road cut, west side of Farm Road 203, 1.3 miles south of intersection with U. S. Highway 67, 6.0 miles southwest of Glen Rose. Paluxy Formation.



Sample number.-- Somervell 3 (64288)

Yield after coning.-- 96.7%

Shape of grains.-- Subrounded

Graphic mean.-- 3.2 $\phi$  (0.11 mm)

Sorting index.-- 0.2 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 80+100                   | 1.8            | 1.8                | 2.8            | 2.8                |
| - 100+140                  | 6.3            | 8.1                | 10.0           | 12.8               |
| - 140+200                  | 55.0           | 63.1               | 87.2           | 100.0              |
| - 200+ pan                 | 36.8           | 99.9               |                |                    |

LOCATION,

TARRANT COUNTY 1. Road cut along black-top road between Farm Road 1886 and Parker County line, 1.2 miles south of Farm Road 1886. Paluxy Formation.

Sample number.-- Tarrant 1 (64289)

Yield after coning.-- 96.8%

Shape of grains.-- Angular to subrounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

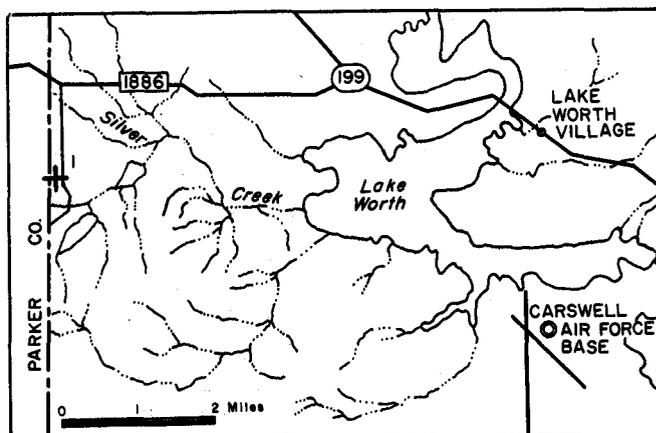
Heavy mineral content.-- 0.046%

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.05%

Calcium oxide content.-- 0.02%

Alumina content.-- 0.52%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.2            | 0.2                | 0.2            | 0.2                |
| - 60+80                    | 1.6            | 1.8                | 2.0            | 2.2                |
| - 80+100                   | 38.6           | 40.4               | 47.9           | 50.1               |
| - 100+140                  | 19.7           | 60.1               | 24.4           | 74.5               |
| - 140+200                  | 20.6           | 80.7               | 25.6           | 100.1              |
| - 200+ pan                 | 19.4           | 100.1              |                |                    |

LOCATION.

TARRANT COUNTY 2. Road cut along private road near end of Lakeside Drive No. 2 off Farm Road 1220, at east edge of Eagle Mountain Lake. Paluxy Formation.

Sample number.-- Tarrant 2-1 (64290)

Yield after coning.-- 97.0%

Shape of grains.-- Angular to subrounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

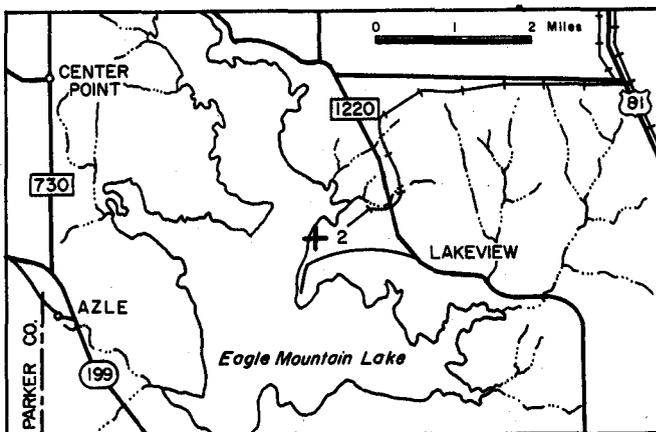
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.04%

Magnesium oxide content.-- 0.05%

Calcium oxide content.-- 0.03%

Alumina content.-- 0.81%



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.2            | 0.2                | 0.5            | 0.5                |
| - 40+60                    | 1.9            | 2.1                | 4.6            | 5.1                |
| - 60+80                    | 0.8            | 2.9                | 2.0            | 7.1                |
| - 80+100                   | 17.3           | 20.2               | 42.3           | 49.4               |
| - 100+140                  | 11.2           | 31.4               | 27.3           | 76.7               |
| - 140+200                  | 9.5            | 40.9               | 23.2           | 99.9               |
| - 200+ pan                 | 49.1           | 100.0              |                |                    |

Sample number.-- Tarrant 2-2 (64291)

Yield after coning.-- 91.3%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.050%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 40+60                          | 18.2              | 18.3                  | 20.0              | 20.1                  |
| - 60+80                          | 14.5              | 32.8                  | 16.0              | 36.1                  |
| - 80+100                         | 41.9              | 74.7                  | 46.1              | 82.2                  |
| - 100+140                        | 10.9              | 85.6                  | 12.0              | 94.2                  |
| - 140+200                        | 5.4               | 91.0                  | 5.9               | 100.1                 |
| - 200+ pan                       | 9.2               | 100.2                 |                   |                       |

Sample number.-- Tarrant 2-3 (64292)

Yield after coning.-- 91.7%

Shape of grains.-- N. D. \*

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.10%

Magnesium oxide content.-- N. D.

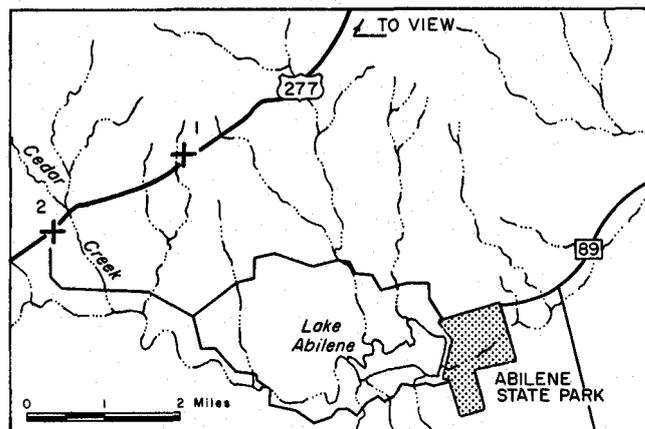
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 2.9               | 2.9                   | 3.4               | 3.4                   |
| - 40+60                          | 9.0               | 11.9                  | 10.7              | 14.1                  |
| - 60+80                          | 4.7               | 16.6                  | 5.6               | 19.7                  |
| - 80+100                         | 41.2              | 57.8                  | 48.8              | 68.5                  |
| - 100+140                        | 14.5              | 72.3                  | 17.2              | 85.7                  |
| - 140+200                        | 12.0              | 84.3                  | 14.2              | 99.9                  |
| - 200+ pan                       | 15.7              | 100.0                 |                   |                       |

LOCATION.

TAYLOR COUNTY 1. Road cut, northwest side of U. S. Highway 277, 5.6 miles southwest of View. Antlers Formation (upper unit).



Sample number.-- Taylor 1-1 (64293)

Yield after coning.-- 98.5%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.5 $\phi$  (0.18 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.16%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.4            | 0.4                | 0.4            | 0.4                |
| - 40+60                    | 10.9           | 11.3               | 11.2           | 11.6               |
| - 60+80                    | 15.4           | 26.7               | 15.7           | 27.3               |
| - 80+100                   | 52.5           | 79.2               | 53.6           | 80.9               |
| - 100+140                  | 4.1            | 83.3               | 4.2            | 85.1               |
| - 140+200                  | 14.6           | 97.9               | 14.9           | 100.0              |
| - 200+ pan                 | 2.2            | 100.1              |                |                    |

Sample number.-- Taylor 1-2 (64294)

Yield after coning.-- 96.6%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.8 $\phi$  (0.14 mm)

Sorting index.-- 0.5 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.08%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 40+60                    | 0.4            | 0.5                | 0.5            | 0.6                |
| - 60+80                    | 1.2            | 1.7                | 1.3            | 1.9                |
| - 80+100                   | 47.3           | 49.0               | 53.2           | 55.1               |
| - 100+140                  | 2.0            | 51.0               | 2.2            | 57.3               |
| - 140+200                  | 38.1           | 89.1               | 42.8           | 100.1              |
| - 200+ pan                 | 11.0           | 100.1              |                |                    |

Sample number.-- Taylor 1-3 (64295)

Yield after coning.-- 94.1%

Shape of grains.-- Subangular to rounded

Graphic mean.--  $2.8\phi$  (0.14 mm)

Sorting index.--  $0.5\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

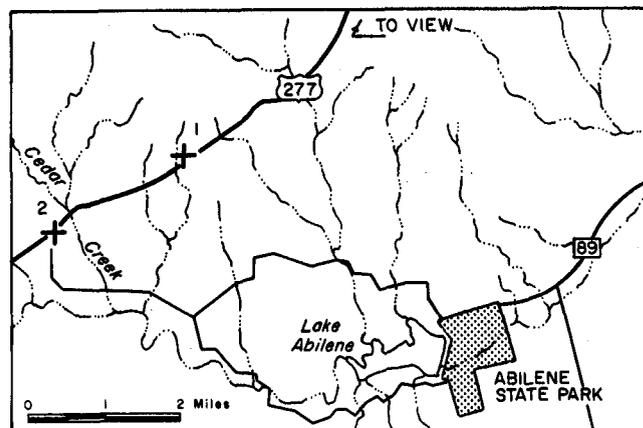
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 1.3               | 1.3                   | 1.5               | 1.5                   |
| - 40+60                          | 1.9               | 3.2                   | 2.2               | 3.7                   |
| - 60+80                          | 1.6               | 4.8                   | 1.9               | 5.6                   |
| - 80+100                         | 37.4              | 42.2                  | 43.3              | 48.9                  |
| - 100+140                        | 3.2               | 45.4                  | 3.7               | 52.6                  |
| - 140+200                        | 41.0              | 86.4                  | 47.4              | 100.0                 |
| - 200+ pan                       | 13.7              | 100.1                 |                   |                       |

#### LOCATION.

TAYLOR COUNTY 2. Road cut along U. S. Highway 277, 7.5 miles southwest of View. Antlers Formation (lower unit).



Sample number.-- Taylor 2-1 (64296)

Yield after coning.-- 91.8%

Shape of grains.-- Subrounded

Graphic mean.--  $2.2\phi$  (0.22 mm)

Sorting index.--  $0.8\phi$  (moderately sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.13%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.1               | 0.1                   | 0.1               | 0.1                   |
| - 40+60                          | 18.1              | 18.2                  | 20.3              | 20.4                  |
| - 60+80                          | 13.8              | 32.0                  | 15.5              | 35.9                  |
| - 80+100                         | 34.0              | 66.0                  | 38.2              | 74.1                  |
| - 100+140                        | 10.1              | 76.1                  | 11.4              | 85.5                  |
| - 140+200                        | 12.8              | 88.9                  | 14.4              | 99.9                  |
| - 200+ pan                       | 10.9              | 99.8                  |                   |                       |

Sample number.-- Taylor 2-2 (64297)

Yield after coning.-- 95.9%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.11%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 1.1            | 1.1                | 1.2            | 1.2                |
| - 40+60                    | 16.7           | 17.8               | 17.5           | 18.7               |
| - 60+80                    | 30.5           | 48.3               | 32.0           | 50.7               |
| - 80+100                   | 40.1           | 88.4               | 42.1           | 92.8               |
| - 100+140                  | 2.4            | 90.8               | 2.5            | 95.3               |
| - 140+200                  | 4.4            | 95.2               | 4.6            | 99.9               |
| - 200+ pan                 | 4.7            | 99.9               |                |                    |

LOCATION.

TAYLOR COUNTY 2A. Road cut along U. S. Highway 277, 7.5 miles southwest of View, immediately south of Taylor County 2. Antlers Formation (2A-1, lower unit; 2A2-3-4-5, upper unit).

Sample number.-- Taylor 2A-1 (64298)

Yield after coning.-- 97.2%

Shape of grains.-- Subrounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.11%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.4            | 0.4                | 0.4            | 0.4                |
| - 40+60                    | 14.5           | 14.9               | 15.0           | 15.4               |
| - 60+80                    | 35.4           | 50.3               | 36.7           | 52.1               |
| - 80+100                   | 42.1           | 92.4               | 43.6           | 95.7               |
| - 100+140                  | 1.2            | 93.6               | 1.2            | 96.9               |
| - 140+200                  | 3.0            | 96.6               | 3.1            | 100.0              |
| - 200+ pan                 | 3.3            | 99.9               |                |                    |

Sample number.--Taylor 2A-2 (64299)

Yield after coning.-- 98.1%

Shape of grains.-- Subangular to well rounded

Graphic mean.-- 2.1 $\phi$  (0.24 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- 0.012%

Iron oxide content.-- 0.05%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.3            | 0.3                | 0.3            | 0.3                |
| - 40+60                    | 14.6           | 14.9               | 15.0           | 15.3               |
| - 60+80                    | 19.1           | 34.0               | 19.6           | 34.9               |
| - 80+100                   | 53.4           | 87.4               | 54.9           | 89.8               |
| - 100+140                  | 7.8            | 95.2               | 8.0            | 97.8               |
| - 140+200                  | 2.0            | 97.2               | 2.1            | 99.9               |
| - 200+ pan                 | 2.6            | 99.8               |                |                    |

Sample number.--Taylor 2A-3 (64300)

Yield after coning.-- 94.4%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.6 $\phi$  (0.17 mm)

Sorting index.-- 0.3 $\phi$  (very well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- > 1.0%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.4            | 0.4                | 0.4            | 0.4                |
| - 40+60                    | 2.8            | 3.2                | 3.1            | 3.5                |
| - 60+80                    | 4.0            | 7.2                | 4.5            | 8.0                |
| - 80+100                   | 41.5           | 48.7               | 46.4           | 54.4               |
| - 100+140                  | 27.4           | 76.1               | 30.7           | 85.1               |
| - 140+200                  | 13.2           | 89.3               | 14.7           | 99.8               |
| - 200+ pan                 | 10.5           | 99.8               |                |                    |

Sample number.--Taylor 2A-4 (64301)

Yield after coning.-- 96.2%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.3 $\phi$  (0.21 mm)

Sorting index.-- 0.7 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.7            | 0.7                | 0.7            | 0.7                |
| - 40+60                    | 15.7           | 16.4               | 16.7           | 17.4               |
| - 60+80                    | 12.2           | 28.6               | 13.0           | 30.4               |
| - 80+100                   | 43.5           | 72.1               | 46.2           | 76.6               |
| - 100+140                  | 8.6            | 80.7               | 9.1            | 85.7               |
| - 140+200                  | 13.4           | 94.1               | 14.2           | 99.9               |
| - 200+ pan                 | 5.7            | 99.8               |                |                    |

Sample number.-- Taylor 2A-5 (64302)

Yield after coning.-- 95.4%

Shape of grains.-- Subangular to rounded

Graphic mean.-- 2.4 $\phi$  (0.19 mm)

Sorting index.-- 0.5 $\phi$  (moderately well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- > 1.0%

Magnesium oxide content.-- N. D.

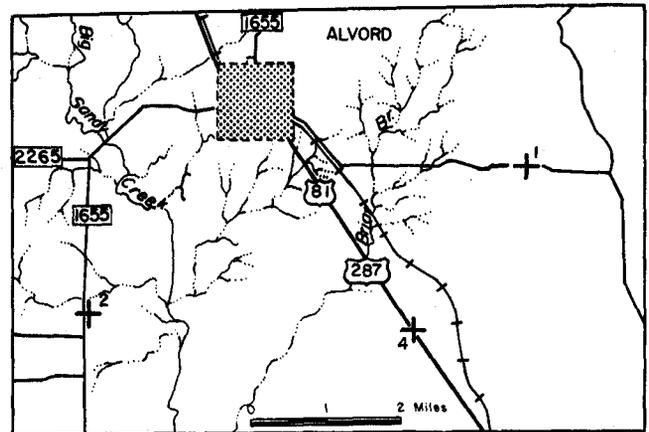
Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 1.1            | 1.2                | 1.3            | 1.4                |
| - 40+60                    | 2.8            | 4.0                | 3.4            | 4.8                |
| - 60+80                    | 3.1            | 7.1                | 3.8            | 8.6                |
| - 80+100                   | 23.0           | 30.1               | 28.4           | 37.0               |
| - 100+140                  | 7.2            | 37.3               | 8.9            | 45.9               |
| - 140+200                  | 43.8           | 81.1               | 54.1           | 100.0              |
| - 200+ pan                 | 19.0           | 100.1              |                |                    |

LOCATION.

WISE COUNTY 1. Road cut along old Decatur-Alvord road, 3.5 miles east of Alvord. Antlers Formation.



Sample number.-- Wise 1 (64303)

Yield after coning.-- 95.4%

Shape of grains.-- Angular to subrounded

Graphic mean.-- 3.0 $\phi$  (0.125 mm)

Sorting index.-- 0.4 $\phi$  (well sorted)

Heavy mineral content.-- N. D.

Iron oxide content.-- 0.12%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.

| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 60+80                    | 0.2            | 0.3                | 0.2            | 0.3                |
| - 80+100                   | 18.6           | 18.9               | 23.2           | 23.5               |
| - 100+140                  | 21.2           | 40.1               | 26.4           | 49.9               |
| - 140+200                  | 40.2           | 80.3               | 50.0           | 99.9               |
| - 200+ pan                 | 19.6           | 99.9               |                |                    |

## LOCATION.

WISE COUNTY 2. Road cut along Farm Road 1655, 3.0 miles southwest of Alvord. Antlers Formation.

Sample number.-- Wise 2 (64304)

Yield after coning.--88.8%

Shape of grains.-- Angular to subrounded

Graphic mean.-- 1.7 $\phi$  (0.31 mm)

Sorting index.-- 0.9 $\phi$  (moderately sorted)

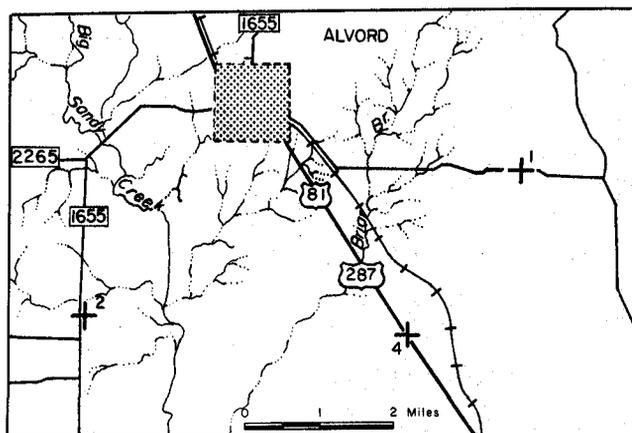
Heavy mineral content.-- 0.047%

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 4.6            | 4.6                | 5.3            | 5.3                |
| - 40+60                    | 35.2           | 39.8               | 40.5           | 45.8               |
| - 60+80                    | 11.8           | 51.6               | 13.5           | 59.4               |
| - 80+100                   | 22.8           | 74.4               | 26.2           | 85.6               |
| - 100+140                  | 8.4            | 82.8               | 9.7            | 95.3               |
| - 140+200                  | 4.0            | 86.8               | 4.6            | 99.9               |
| - 200+ pan                 | 13.0           | 99.8               |                |                    |

## LOCATION.

WISE COUNTY 3. Road cut along Farm Road 730 at south city limit of Decatur. Paluxy Formation.

Sample number.-- Wise 3 (64308)

Yield after coning.-- 97.8%

Shape of grains.-- Subangular to subrounded

Graphic mean.-- 2.3 $\phi$  (0.21 mm)

Sorting index.-- 0.6 $\phi$  (moderately well sorted)

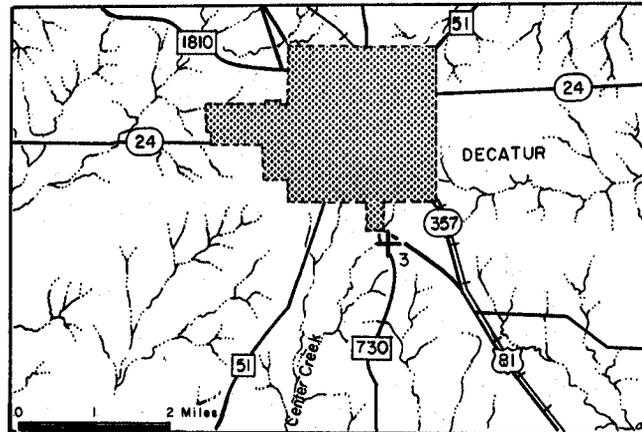
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.09%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 20+40                    | 0.6            | 0.7                | 0.6            | 0.7                |
| - 40+60                    | 13.5           | 14.2               | 14.1           | 14.8               |
| - 60+80                    | 17.1           | 31.3               | 17.8           | 32.6               |
| - 80+100                   | 35.4           | 66.7               | 36.9           | 69.5               |
| - 100+140                  | 15.9           | 82.6               | 16.6           | 86.1               |
| - 140+200                  | 13.2           | 95.8               | 13.7           | 99.8               |
| - 200+ pan                 | 3.9            | 99.7               |                |                    |

LOCATION.

WISE COUNTY 4. Road cut along U. S. Highway 81, 3.0 miles southeast of Alvord. Antlers Formation.

Sample number.-- Wise 4 (64305)

Yield after coning.-- 96.7%

Shape of grains.-- Rounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

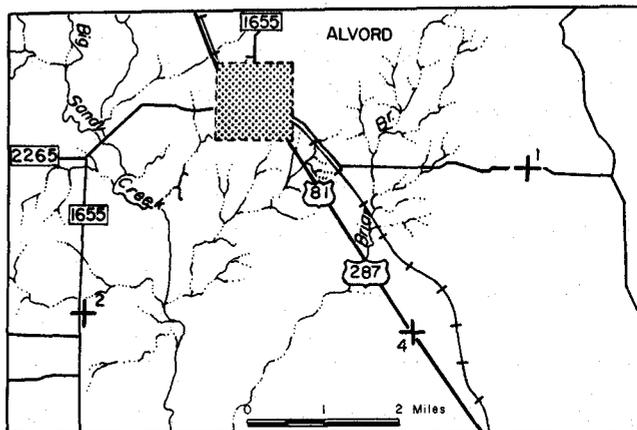
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.07%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 80+100                   | 1.1            | 1.1                | 1.4            | 1.4                |
| - 100+140                  | 10.1           | 11.2               | 13.1           | 14.5               |
| - 140+200                  | 65.6           | 76.8               | 85.4           | 99.9               |
| - 200+ pan                 | 23.1           | 99.9               |                |                    |

LOCATION.

WISE COUNTY 5. Road cut along U. S. Highway 81, 3.3 miles northwest of Decatur. Antlers Formation.

Sample number.-- Wise 5 (64306)

Yield after coning.-- 95.6%

Shape of grains.-- Rounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

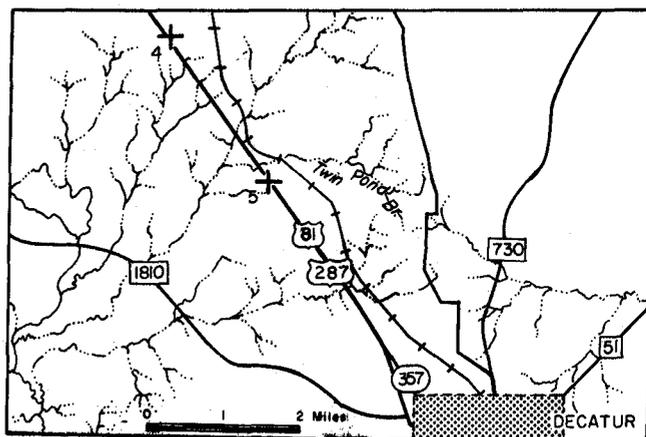
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.11%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S. Standard Mesh Number | Entire sample  |                    | Sand fraction  |                    |
|----------------------------|----------------|--------------------|----------------|--------------------|
|                            | Weight Percent | Cumulative Percent | Weight Percent | Cumulative Percent |
| - 10+20                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 20+40                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 40+60                    | 0.0            | 0.0                | 0.0            | 0.0                |
| - 60+80                    | 0.1            | 0.1                | 0.1            | 0.1                |
| - 80+100                   | 1.0            | 1.1                | 1.4            | 1.5                |
| - 100+140                  | 5.6            | 6.7                | 7.7            | 9.2                |
| - 140+200                  | 66.0           | 72.7               | 90.7           | 99.9               |
| - 200+ pan                 | 27.2           | 99.9               |                |                    |

## LOCATION.

WISE COUNTY 6. Road cut along Farm  
Road 730, 2.0 miles north of Boyd.  
Paluxy Formation.

Sample number.-- Wise 6 (64307)

Yield after coning.-- 92.7%

Shape of grains.-- Angular to subrounded

Graphic mean.--  $3.2\phi$  (0.11 mm)

Sorting index.--  $0.2\phi$  (very well sorted)

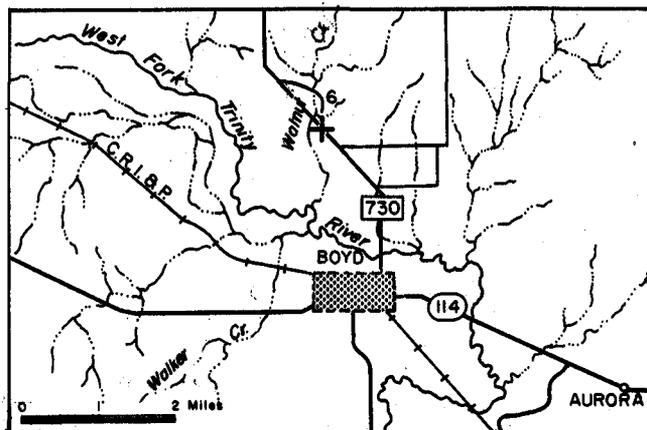
Heavy mineral content.-- N. D.

Iron oxide content.-- 0.06%

Magnesium oxide content.-- N. D.

Calcium oxide content.-- N. D.

Alumina content.-- N. D.



| U. S.<br>Standard<br>Mesh Number | Entire sample     |                       | Sand fraction     |                       |
|----------------------------------|-------------------|-----------------------|-------------------|-----------------------|
|                                  | Weight<br>Percent | Cumulative<br>Percent | Weight<br>Percent | Cumulative<br>Percent |
| - 10+20                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 20+40                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 40+60                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 60+80                          | 0.0               | 0.0                   | 0.0               | 0.0                   |
| - 80+100                         | 1.0               | 1.0                   | 1.6               | 1.6                   |
| - 100+140                        | 5.3               | 6.3                   | 8.8               | 10.4                  |
| - 140+200                        | 54.1              | 60.4                  | 89.4              | 99.8                  |
| - 200+ pan                       | 39.3              | 99.7                  |                   |                       |

INDEX

- abrasives: 20  
 abrasive sands: 17, 20, 21  
 acid washing: 19  
 aggregate: 17  
 air separation: 19  
 alkalis: 17  
 alumina: 16, 17, 28  
     content, determination of: 28  
 analysis, sieve: 28  
 annual consumption--  
     industrial sand: 20  
     silica sands: 1  
 annual production--  
     industrial sands: 20  
     silica sands: 1  
 Antlers Formation: 1, 3, 5, 7, 10, 15, 16, 22  
 aquifers, fresh water: 1  
 areal distribution: 2  
 Arkansas: 20  
 asphaltic mixtures: 17  
 attrition scrubbing: 19  
 autoclave cement: 17, 24  
 average value, industrial sand: 21  
  
 ballast: 17  
 Barnes and Schofield: 1  
 base oxides: 17  
 basinal sequence: 1, 3, 12  
 beneficiation: 1, 19  
 Bexar County: 20  
 biotite: 16  
 blasting: 19  
 blast sand: 17, 20, 21  
 Bosque County: 1, 2, 5  
     results of tests: 31-33  
 Brazos River: 5, 22  
 Brown, T. H.: 1  
 Brownwood: 10  
 Brown County: 2, 3, 5, 7, 10  
 Burnet: 5  
 Burnet County: 5  
  
 calcareous gravel: 7  
 calcite: 5  
 calcium oxide: 16, 28  
     content, determination of: 28  
 Callahan County: 1, 2, 5, 7, 24  
     results of tests: 34-36  
 Callahan Divide: 7, 19  
 Cambrian sands: 1  
 Capitol Silica Products Company: 1, 25  
 Casey, Josephine: 1  
 Catlet Creek: 10  
 Cenozoic sands, South Texas: 1  
 Central Texas: 1, 10, 12  
     Cambrian sands: 1  
 ceramic material: 21  
 chemical composition: 16, 19  
 chemical manufacturing: 17  
  
 chemical purity: 19, 22  
 chemical sands: 17  
 chert: 15  
     dark colored: 19  
 chlorite: 16  
 classifiers: 19  
     rake and screw: 19  
 clay minerals: 15  
 Clear Creek: 10  
 Cleburne: 20  
 Coastal Plain, Texas: 1  
 coastal sands, Texas: 1  
 Coke County: 2, 7  
 Coleman County: 1, 2, 5, 7, 19, 20  
     results of tests: 36-37  
 Colorado County: 20  
 Colorado River: 5  
 Columbus: 20  
 Comanche County: 1, 2, 5  
     results of tests: 37-40  
 concentrating tables: 19  
 conglomerates: 7  
     dolomite-, limestone-pebble: 15  
     siliceous: 10  
 conical mills: 19  
 consumption--  
     annual, silica sands: 1  
     sands: 20  
 Cooke County: 1, 2, 10  
     results of tests: 40-45  
 Copperas Creek: 7  
 core sand: 17  
 Corsicana: 20  
 Coryell County: 1, 2, 5  
     results of tests: 45  
 Cow Creek Limestone: 1, 12  
 Cow House Creek: 5  
  
 Dallas: 21, 22  
 dark-colored chert: 19  
 decanting: 19  
 Decatur: 10  
 definition, sand terms: 17  
 Denton County: 1, 2, 10  
     results of tests: 46  
 depositional surface, pre-Cretaceous: 7  
 deposits, principal: 22  
 description of samples: 28  
 determination of--  
     alumina content: 28  
     calcium oxide content: 28  
     iron oxide content: 28  
     magnesium oxide content: 28  
     statistical values: 28  
 dolomite: 15  
 dolomite-pebble conglomerate: 15  
 Dublin: 3  
  
 Eastland County: 2, 5, 7

- East Texas: 20  
     Cenozoic sands: 1  
 Edwards Formation: 2  
 Edwards Plateau: 7  
 Eifler, Gus K., Jr.: 1  
 electrostatic processing: 19  
 electrostatic separation: 19  
 Ellis County: 21  
 Elm Fork: 10  
 engine sand: 17, 20, 21  
 Erath County: 1, 2, 3, 5  
     results of tests: 46-64  
 facies: 1  
 feldspar: 15, 16  
 ferrosilicon: 17  
 fiberglass: 21  
     manufacture: 24  
 field sampling: 28  
 fill: 17  
 filter-media sands: 17  
 filter sand: 20  
 Fisher and Rodda: 3  
 Fisher, W. L.: 1  
 Flawn, Peter T.: 1  
 flotation: 19  
 fluorite: 16  
 fluxes: 17  
 Folk, R. L.: 28, 29  
 Fort Worth: 22  
 foundry sands: 17, 20, 21, 24  
 Fredericksburg formations: 7  
 Freestone County: 20  
 fresh-water aquifers: 1  
 front-end loaders: 19  
 furnace-bottom sand: 17  
  
 gannister mix: 17  
 Garner, L. E.: 1  
 garnet: 16  
 glass manufacture: 17, 24  
 glass sand: 17, 20, 25  
 Glen Rose Formation: 1, 3, 5, 7, 10  
 Glen Rose isopachs: 5  
 Goldthwaite: 10  
 grain size: 15, 19  
     distribution: 15, 22  
 gravel: 7  
 grinding sand: 17  
 ground silica: 25  
     sand: 20  
 Guion District, Arkansas: 20  
 gypsum plaster board: 17  
  
 Hamilton County: 1, 2, 5  
     results of tests: 64-65  
 Hammett Shale: 1  
 Hardin County: 20  
 hard rubber: 17  
 Heart of Texas Mining Corporation: 1, 25  
 heavy media separation: 19  
 heavy minerals: 15, 19, 28  
  
     analysis: 28  
     content: 16  
     hematite: 16, 19  
 Hensel Formation: 1, 3  
 Hensel Sand: 1  
 Hickory sands: 25  
 Hill County: 21  
 Hillsboro: 21  
 Hog Mountain: 5  
 Hood County: 1, 2, 3, 5  
     results of tests: 66-68  
 Hosston Formation: 1, 3  
 Houston: 20, 21  
 Howard County: 7  
 hydraulic dredges: 19  
 hydraulic-fracturing sands: 17, 20, 21, 25  
 ilmenite: 16  
 imports: 20  
 industrial sand: 17, 24, 25  
     annual consumption: 20  
     annual production: 20  
     average value: 21  
 iron oxide: 17, 19, 22, 28  
     content: 16, 28  
     determination of: 28  
 impurities: 16  
  
 Jack County: 5  
  
 Kosse: 20  
  
 laboratory preparation of sand samples: 28  
 Lampasas Cut Plain: 2, 19  
 Leon River: 5, 7  
 Liberty County: 20  
 lightweight minerals: 15  
 limonite: 16, 19  
 limestone: 15  
     -pebble conglomerate: 15  
 Limestone County: 20, 25  
 liquid-cyclone separators: 19  
 Llano Uplift: 7, 12  
 long-tube mills: 19  
  
 McCabe, Henry: 1  
 McCulloch County: 7, 20, 25  
 McLennan County: 5  
 Macon, J. W.: 1  
 magnesium oxide: 16, 28  
     content, determination of: 28  
 Magnet Cove Barium Corporation: 25  
 magnetic separators: 19  
 magnetite: 16, 19  
 markets, principal: 20  
 Maxwell, R. A.: 1  
 May: 5  
 Mayfield, R. B.: 1  
 mean grain size: 15  
 Menard County: 7  
 metallurgical sands: 17  
 methodology: 28-29

- Mid-Continent Glass Sand Corporation: 25  
 Midwestern States: 20  
 Mill Creek District, Oklahoma: 20, 25  
 milling: 19  
 Mills County: 2, 5, 10, 12  
 mills, kinds of: 19  
 mineral composition: 15-16  
 mineral fillers: 21  
 mining: 19  
 molding sand: 17, 20  
 Montague County: 1, 2, 10  
     results of tests: 69-77  
 Nolan County: 1, 2, 7, 24  
     results of tests: 77-82  
 nomenclature: 3  
 North-central Texas: 1, 2, 3, 5, 10, 12, 15, 16,  
     19, 22, 24, 25  
     sequence: 7  
 North Fish Creek: 10  
 North Texas: 1, 2, 3, 5, 10, 15, 16, 19, 22  
  
 Oklahoma: 20, 25  
 open-pit mining: 19  
 overburden: 19  
  
 paint: 17  
 Palestine: 20  
 Paluxy Cross Timbers: 5  
 Paluxy Formation: 1, 3, 5, 7, 10, 15, 16, 22  
 Paluxy River: 3  
 Parker County: 1, 2, 3, 5, 22  
     results of tests: 82-101  
 particle-size distribution: 28  
 paste-wood filler: 17  
 Payne, W. R.: 1  
 Pearsall Formation: 1, 3  
 pebble mills: 19  
 Pennsylvania Glass Sand Corporation: 25  
 placing sand: 17  
 Polk County: 20  
 pre-Cretaceous--  
     depositional surface: 7  
     topographic high: 7  
     topography: 12  
 preparation of sand samples: 28  
 principal deposits: 22  
 processing: 19  
 production, annual--  
     industrial sands: 20  
     silica sands: 1  
 pulverized sand: 17, 19  
 purity, chemical: 19, 22  
  
 quality, sands: 19  
 quartz: 15, 16  
  
 rake-classifiers: 19  
 Red River: 10  
 refractory sands: 17  
 Runnels County: 2, 7  
 runner sand: 17  
  
 rutile: 16  
  
 Sabana River: 7  
 Salt Creek: 10  
 sampling, field: 28  
 sand roughs: 3  
 sand samples, preparation of: 28  
 sand-sized particles, yield of: 15  
 San Jacinto County: 20  
 Santa Anna: 19, 20  
 Santa Anna Mountain: 7  
 Santa Anna Silica Sand Company: 1, 25  
 sawing sand: 17  
 Schleicher County: 7  
 Schofield, D. A.: 1  
 screw-classifiers: 19  
 separators, liquid-cyclone: 19  
 short ball mills: 19  
 short-tube mills: 19  
 Shreveport, Louisiana: 20  
 Sidwell, Raymond: 16  
 sieve analysis: 28  
 silica: 16  
     alloys: 17  
     flour: 17, 19, 20, 21, 25  
     sand: 17, 19, 20, 21  
         annual consumption and production: 1  
 silicates, soluble: 17, 21, 24  
 siliceous conglomerates: 10  
 siliceous gravel: 7  
 silicon carbide: 17  
 Sligo Formation: 1, 3  
 Smith County: 20  
 soluble silicates: 17, 21, 24  
 Somervell County: 1, 2, 5, 20  
     results of tests: 101-102  
 sorting: 15  
 Southeast Texas: 20  
 South Fish Creek: 10  
 South Texas Cenozoic sands: 1  
 special foundry sands: 20  
 specialty sand: 17, 20  
 specifications, industrial sands: 17  
 Spring Mesa: 5, 7  
 statistical values, determination of: 28  
 staurolite: 16  
 stratigraphic sequences: 3-12  
 stucco plaster: 17  
 Sutton County: 7  
 Sycamore Sand: 1  
  
 Table Mountain: 7  
 Talpa: 7  
 Tarrant County: 1, 5, 22  
     results of tests: 103-104  
 Taylor County: 1, 2, 7, 24  
     results of tests: 105-109  
 Texas Coastal Plain: 1  
 Texas coastal sands: 1  
 titanium oxide: 16  
 Tom Green County: 7

topaz: 16  
 topographic high, pre-Cretaceous: 7  
 tourmaline: 16  
 traction sand: 17  
 Travis County: 12  
 Travis Peak Formation: 1, 3, 10, 12, 15, 16  
 Trinity River: 10  
 Twin Mountains: 3  
 Twin Mountains Formation: 1, 3, 5, 7, 10, 15,  
 16, 22  
 Twin Mountains--Glen Rose--Paluxy sequence: 7  
  
 Upper Cross Timbers: 3, 10  
 Upshur County: 20  
 utilization: 17  
  
 Valera: 7  
 value--

average, industrial sand: 21  
 sands: 20  
 Voca: 20  
 Waco: 5, 20, 24  
 Walnut Formation: 5  
 Waxahachie: 21  
 Weatherford: 3  
 West-central Texas: 1, 2, 3, 5, 7, 10, 15, 16,  
 19, 22, 24  
 Western Cross Timbers: 2, 3, 10  
 West Texas: 5  
 Wilcox sands: 25  
 Wise County: 1, 2, 3, 5, 7, 10  
 results of tests: 109-112  
 Wood County: 20  
  
 yield of sand-sized particles: 15  
  
 zircon: 16