# OKLAHOMA GEOLOGY

Vol. 55, No. 6
December, 1995

## On The Cover —

### Soft-Sediment Deformation in Sandstones of the Savanna Formation

The cover photograph, taken in Pittsburg County, Oklahoma, shows a cross-sectional view of convolute bedding at the top of a very fine grained sandstone bed. The geologic pick is 1.1 ft long. The sandstone bed is the basal unit of the Savanna Formation—Psv1a (see feature article, this issue).

Note the complex set of folds at the top of the bed and the way the folds die out toward the base. The synclines tend to be broad and open, and the anticlines tight and peaked. Pettijohn and others (1987) say that convolute bedding is one of the structures most difficult to explain. The folds are not of the ordinary kind; they do not record lateral compression, nor are they elongated. The bedding plane section shows them to be a series of sharp domes and basins (see inset photo A, which is a plan view of the convoluted upper surface of the sandstone bed shown in the cover photograph).

*(continued on p. 225)*




**OKLAHOMA GEOLOGICAL SURVEY**

CHARLES J. MANKIN
*Director*

KENNETH S. JOHNSON
*Associate Director*

**OKLAHOMA GEOLOGY NOTES**

*Editor*
Christie Cooper

*Editorial Assistant*
Tracy Peeters

*Cartography*
T. Wayne Furr, *Manager*
James H. Anderson
Charlotte Lloyd

*OKLAHOMA GEOLOGY NOTES*, ISSN 0030-1736, is published bimonthly by the Oklahoma Geological Survey. It contains short technical articles, mineral-industry and petroleum news and statistics, abstracts, notices of new publications, and announcements of general pertinence to Oklahoma geology. Single copies, $1.50; yearly subscription, $6. Send subscription orders to the Survey at 100 E. Boyd, Room N-131, Norman, OK 73019. Short articles on aspects of Oklahoma geology are welcome from contributors; general guidelines will be sent on request.

This publication, printed by the Oklahoma Geological Survey, Norman, Oklahoma, is issued by the Oklahoma Geological Survey as authorized by Title 70, Oklahoma Statutes 1981, Section 3310, and Title 74, Oklahoma Statutes 1981, Sections 231–238. 1,500 copies have been prepared for distribution at a cost of $1,660 to the taxpayers of the State of Oklahoma. Copies have been deposited with the Publications Clearinghouse of the Oklahoma Department of Libraries.

# KLAHOMA GEOLOGY

# Notes



VOL. 55, NO. 6
DECEMBER 1995

LAHOMA GEOLOGICAL SURVEY

# Principal Reference Section (Neostratotype) for the Savanna Formation, Pittsburg County, Oklahoma

*LeRoy A. Hemish*[1]

## Abstract

A 1,714.1-ft section measured and described in the south limb of the Sans Bois syncline just northwest of the town of Adamson (Adamson 7.5′ topographic quadrangle) is herein designated as the principal reference section for the Savanna Formation (Pennsylvanian). Although the Savanna Formation is a long- and well-established stratigraphic unit, a formal type section never was specified. The Adamson section has been selected as the neostratotype for the Savanna on the basis of (1) accessibility of rocks in place; (2) excellent exposures, including both the upper and lower contacts as well as lithologic units immediately above and below the contacts; (3) geographic location within the type area (central Pittsburg County); and (4) close adherence to the original sense in which the Savanna Formation was defined by its nomenclator.

## Introduction

The purpose of this paper is to formally present and describe a principal reference section for the Savanna Formation. A type section never was specified, nor was a type locality specifically stated. Presumably, it is in the vicinity of the town of Savanna, in central Pittsburg County (Fig. 1). Recognizing the need for a standard to serve for definition and recognition of the Savanna, I concluded that a principal reference section should be established, in accordance with Article 8e, North American Stratigraphic Code (1983, p. 853).

As a first step in the procedure, I conducted a reconnaissance of the area around the town of Savanna to determine if an appropriate section could be measured there. Except for low ribs of sandstone protruding through extensive expanses of grassed-over, low-relief landscape, and an occasional road cut where a few feet of shale is exposed, virtually none of the Savanna Formation can be seen in that area. Nor could I find exposures of either the lower or upper boundaries of the formation. Therefore, I shifted my focus north and east, to the synclinal Sans Bois Mountains where the Savanna Formation is well exposed in the flanks of the range. While working on a different mapping project, I was fortunate to discover a nearly ideal area just northwest of the town of Adamson (Fig. 1) within the type area of the Savanna Formation in Pittsburg County, where both the upper and lower contacts of the Savanna are well exposed. Although some intervals (presumed to be predominantly shale) are covered in the Adamson section, it is unrealistic to expect to find a completely exposed, unbroken and continuous sequence of strata in a formation ~1,450 ft thick.

The location of the neostratotype is sufficiently close to the type locality (Savanna, Oklahoma) to preserve this well-established name and maintain stability of Oklahoma's stratigraphic nomenclature.

---

[1]Oklahoma Geological Survey.

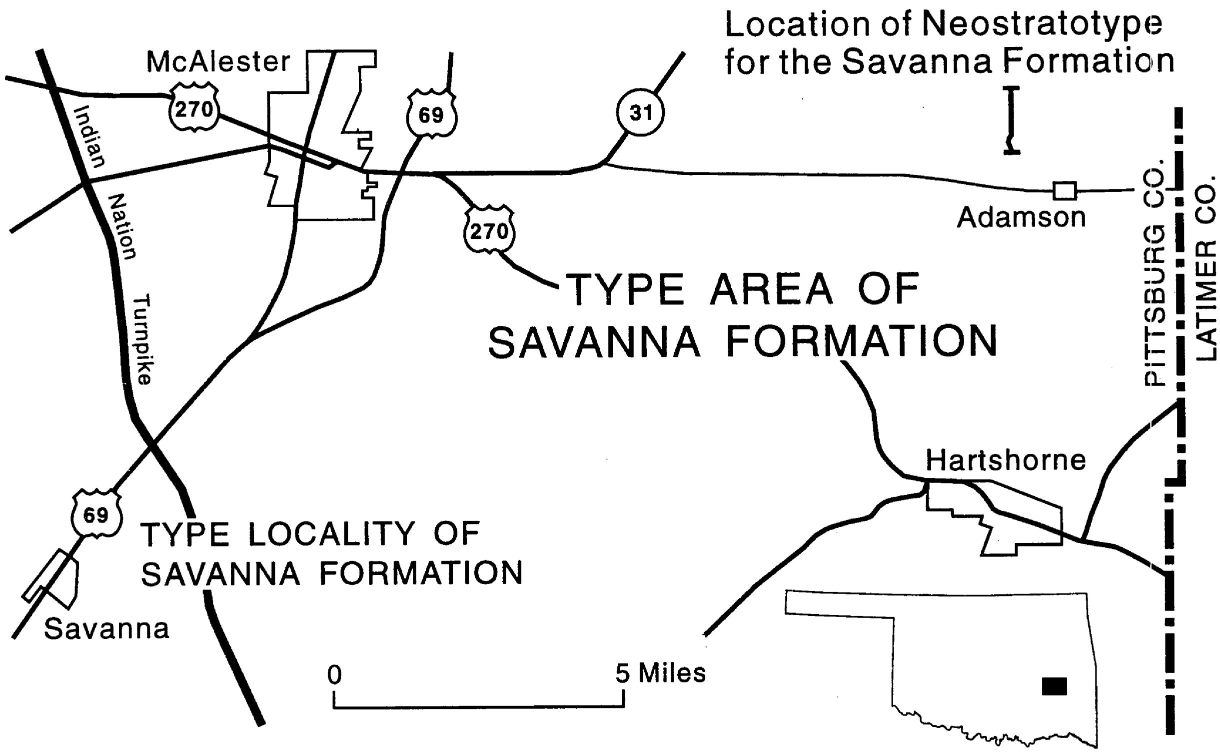



Figure 1. Map showing the type locality, type area, and location of the neostratotype for the Savanna Formation in central Pittsburg County, Oklahoma.

## Previous Investigations

The Savanna Formation (Savanna sandstone as originally defined) was named and first described by Taff (1899, p. 437–438). In his original description, Taff said:

> Next above the McAlester shale there is a series of sandstones and shales about 1,150 feet thick. The shaly beds combined are probably thicker than the sandstones, but since the sandstones are better exposed and their presence is so strongly impressed upon the observer in the prominent ridges which they make, sandstone seems the more appropriate term. There are five principal sandstone beds, which have different thicknesses, from nearly 50 to 200 feet, the one at the top and the one at the base being generally thicker than the intermediate ones. The sandstones may be distinguished only by their position in the section or their thickness of bedding. They are brown or grayish-brown, fine-grained and compact. Except in the uppermost beds, upon which the town of McAlester is built, the beds are generally thin and in part shaly. The uppermost sandstone occurs in two members, 75 to 100 feet thick, separated by variable blue clay shales. The uppermost beds of this sandstone are found in many places to be massive, and those in contact with the shale are often beautifully ripple-marked. No coal of any value has been found associated with these beds of sandstone in the McAlester district, though a thin bed has been reported to occur in the upper part of the series.

Taff and Adams (1900, p. 277–278) subsequently wrote about the Savanna Formation in the area from the east line of Pittsburg County to the Arkansas/Oklahoma line. They said that the formation "contains three prominent divisions or collections of sandstone beds...separated by masses of shale and thin sandstone....The shales of this formation are as a whole more sandy than shales of the formation below, though they are friable and disintegrate readily, forming valleys and level stretches of country. Estimates of the thickness of this formation vary from 1,200 feet to 1,500 feet."

Because the original description of the Savanna Formation was somewhat vague, because its individual beds are of variable nature, and because there was no precise measured section defining an upper and lower boundary, various writers have included more or less than the equivalents of the original Savanna of Taff (1899). Figure 2 shows the changing concepts of the McAlester/Savanna and Savanna/Boggy boundary positions in Oklahoma through time. The neostratotype includes within the Savanna Formation the strata currently recognized by the Oklahoma Geological Survey (OGS).

In the Arkoma basin area the Savanna Formation subsequently was investigated and described by Snider (1914), Morgan (1924), Wilson (1935), Wilson and Newell (1937), Hendricks (1937, 1939), Knechtel (1937, 1949), Dane and others (1938), Oakes and Knechtel (1948), Russell (1960), Vanderpool (1960), Webb (1960), Hemish (1990a,b; 1991a,b; 1992; 1993; 1994; 1995; in preparation [Geology of the Sans Bois syncline along the proposed route of State Highway 82, Haskell and Latimer Counties, Oklahoma]), Hemish and others (1990a,b,c), Hemish and Mazengarb (1992), and Hemish and Suneson (1993, 1994).

Numerous stratigraphic sections have been measured by many of the early workers; however, when referring to these sections, the reader should keep in mind that reported thicknesses for the Savanna Formation are inaccurate by today's standards. Prior to 1954, changes in definitions of the upper and lower boundaries of the Savanna created the impression of a much thicker, or much thinner, formation (Fig. 2). For many years the thick shale unit at the top of the Savanna Formation (as currently defined) was included in the overlying Boggy Formation. Miser (1954) established the contact between the Savanna Formation and the Boggy Formation at the base of the Bluejacket Sandstone Member of the Boggy in the course of preparation of the Geologic Map of Oklahoma. No further changes involving the thickness of the Savanna have been made since that time.

## Stratigraphy

Figure 3 is a modified excerpt from the geologic map of the Adamson 7.5′ quadrangle (Hemish, 1995) showing the location of the neostratotype for the Savanna Formation. Bedrock units exposed in the map area (Fig. 3) include the Warner Sandstone Member of the McAlester Formation; the Cameron Sandstone Member of the McAlester Formation; the Keota Sandstone Member of the McAlester Formation; the Savanna Formation; and, on the north side of Buffalo Creek, the Bluejacket Sandstone Member of the Boggy Formation, along with some of the overlying, unnamed units in the Boggy. All of the strata are in the Krebs Group, middle Desmoinesian Series, Pennsylvanian System (see Explanation, Fig. 3).

The strata comprising the Savanna Formation have been characterized as extremely variable throughout the Arkoma basin, both lithologically and in thickness. Morgan (1924, p. 74–75) measured a section in T. 1 N., R. 7 E., and noted that "the formation consists of alternating shales and sandstones, with occasional thin, impure limestones." Its thickness is ~1,300 ft at that location. Near the bottom, it includes a thin limestone bed, "well exposed in the road in front of J. S. Jolly's house, 300 yards east of the northwest corner of sec. 8, T. 1 N., R. 7 E." Morgan (1924, p. 74) named the limestone the "Jolly Limestone Member" and said it occurs ~100 ft

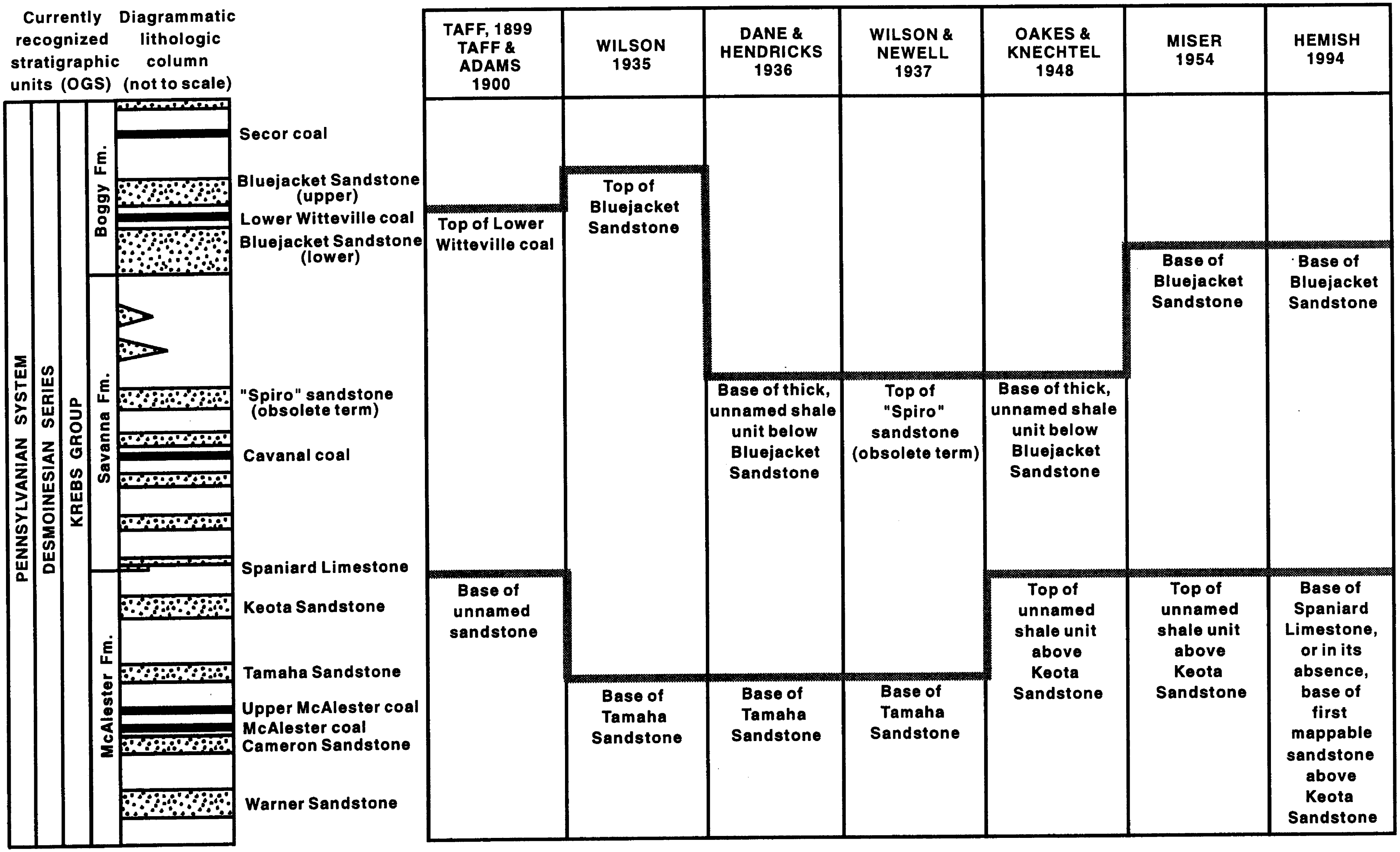



Figure 2. Concepts of the McAlester/Savanna and Savanna/Boggy boundary positions in Oklahoma (from Hemish, 1994, fig. 7).

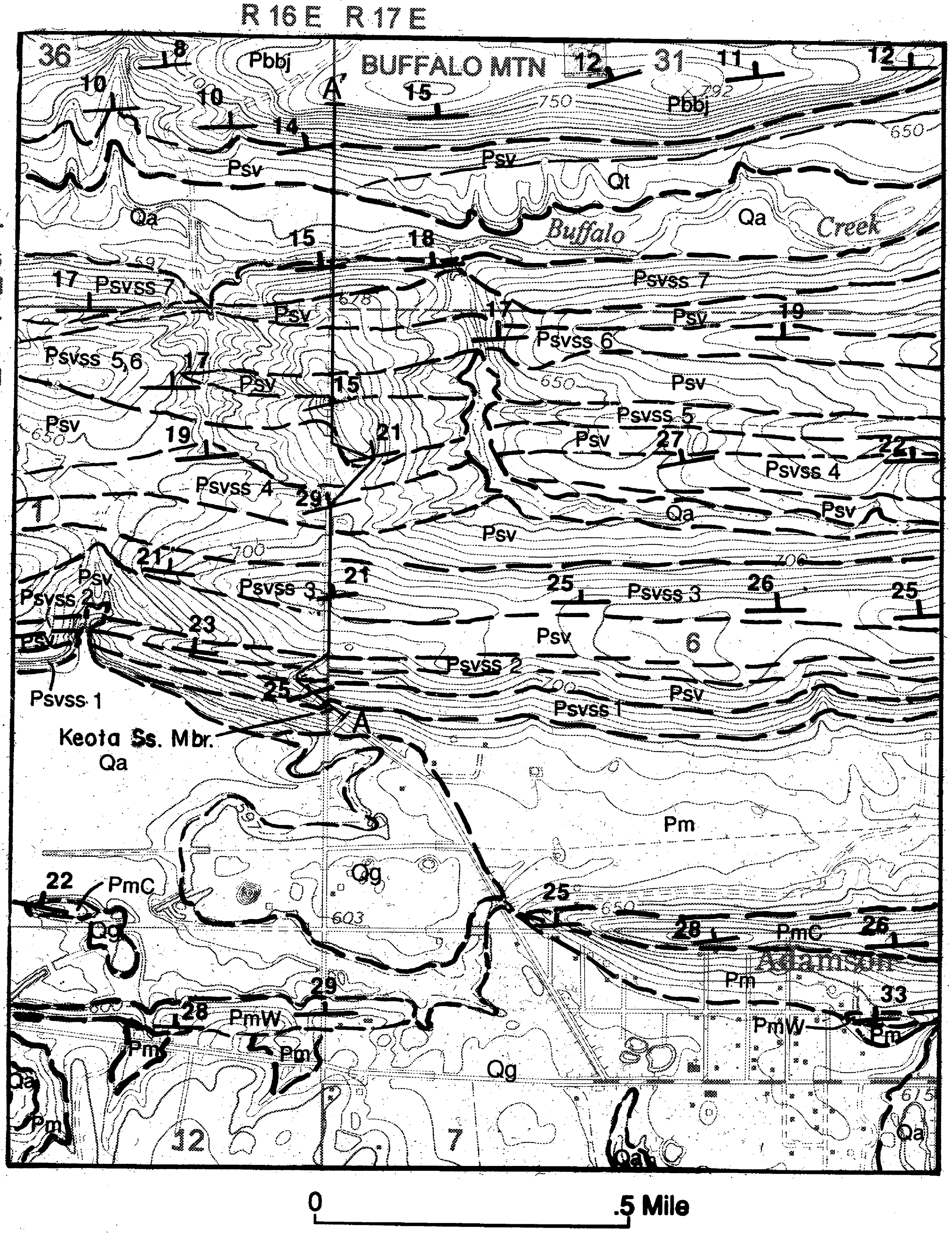



Figure 3. Geologic map of the northwest Adamson area, base taken from the Adamson 7.5′ quadrangle, showing the location of the neostratotype for the Savanna Formation (modified from Hemish, 1995). (See explanation on opposite page.)

above the top of the McAlester Formation. In places it may be as much as 200 ft higher.

Writing about the McAlester district, Hendricks (1937, p. 17) said: "The Savanna sandstone is extremely variable in character throughout the district. It consists of 5 to 13 distinguishable sandstone beds separated by shale." He went on to say (p. 17) that "it was impossible to trace each individual sandstone bed, and for convenience in mapping several sandstones separated by thin shale beds were mapped together as sandstone groups." Hendricks (1937, p. 16) was of the opinion that "the Savanna rests unconformably on the McAlester shale" although only minor erosional contacts were observed in exposures in the McAlester district. In the McAlester area "the Savanna sandstone ranges from 1,120 to 1,325 feet in thickness in measured sections" (Hendricks, 1937, p. 19).

Dane and others (1938, p. 158) said that "the Savanna sandstone is extremely variable in character from place to place, owing to lenticularity and lack of continuity of many of the sandstone beds which it contains." At several localities in T. 7 N., R. 17 E., the northern part of T. 7 N., R. 18 E., and the southeast corner of T. 8 N., R. 18 E., Dane and others (1938, p. 159–160) reported "outcrops of thin fossiliferous limestone beds at horizons from 150 to 180 feet below the top of the Savanna sandstone." They also observed an 8-in.-thick bed of sandy limestone at several localities in secs. 9 and 10, T. 6 N., R. 17 E. at a horizon ~300 ft below the top of the Savanna.

Oakes and Knechtel (1948, p. 44) noted that the Savanna Formation "is a succession of sandstone and shale beds in which shale predominates but sandstone is most conspicuous in outcrops. It contains a minor amount of limestone in thin lenses and beds, and fossils of both marine animals and land plants are present locally." The formation is 500–1,150 ft thick in southern Haskell County, 80 ft thick in southern Muskogee County, and ~25 ft thick in the latitude of Muskogee (Oakes and Knechtel, 1948, p. 45). Although it is well known that the formations in the Krebs Group thin to the north out of the Arkoma basin, the thickness of 25 ft for the Savanna Formation at Muskogee seems erroneous. Hemish (1990a, p. 37–39, 50–51) described 82.9 ft of core from the Savanna in Mayes County (north of Muskogee), and 70.0 ft of core from the same formation in Craig County, <15 mi from the Oklahoma/Kansas line. Fur-

**EXPLANATION**

| | | | | |
|---|---|---|---|---|
| QUATERNARY | | | Qa | Recent alluvium |
| | | | Qt | Quaternary terrace |
| | | | Qg | Gerty Sand |
| PENNSYLVANIAN | Desmoinesian | Krebs Group | Pbbj | Boggy Formation; Bluejacket Sandstone Mbr. |
| | | | Psv | Savanna Formation; unnamed shale members |
| | | | Psvss | Savanna Formation; sandstone units 1–7 |
| | | | Pm | McAlester Formation; shale members |
| | | | PmC | McAlester Formation; Cameron Sandstone Mbr. |
| | | | PmW | McAlester Formation; Warner Sandstone Mbr. |

– – – Contact; approx. located

⊥14 Strike and dip of beds

thermore, in southern Haskell County, Oakes and Knechtel (1948, appendix 5) described strata in the Savanna Formation that total 1,390 ft, not in agreement with their statement that the formation is 500–1,150 ft thick in southern Haskell County.

Knechtel (1949, p. 27) said that the lower sandstone unit of the Savanna Formation (which marks the contact between the McAlester Formation and the Savanna Formation in the neostratotype [Appendix]) "cannot be traced farther north than sec. 18, T. 9 N., R. 19 E., northwestern Haskell County." He observed that this horizon "seems to occupy about the same stratigraphic position as the Spaniard Limestone." Throughout the northeastern Oklahoma shelf area, the base of the Spaniard Limestone marks the McAlester/Savanna contact. Hemish (1993) tentatively identified a limestone discovered in Le Flore County, in the eastern part of the Arkoma basin of Oklahoma, as the Spaniard Limestone, and used its base to define the McAlester/Savanna contact in that area.

Coal beds have been observed in the Savanna Formation throughout the Arkoma basin (Taff, 1899; Taff and Adams, 1900; Hendricks, 1937; Dane and others, 1938; Hendricks, 1939; Oakes and Knechtel, 1948; Knechtel, 1949; Russell, 1960; Webb, 1960; Hemish, in preparation [Geology of the Sans Bois syncline along the proposed route of State Highway 82, Haskell and Latimer Counties, Oklahoma]), but most are thin and discontinuous. Knechtel (1949, p. 49) reported that "three and possibly four minable coal beds within the Savanna Formation crop out in... Cavanal Mountain." If minable coals are present elsewhere in the Arkoma basin within the Savanna Formation, they have not been discovered to date.

The concept of mapping the sandstones of the Savanna Formation by "groups" or "divisions" based on topographic expression was originated by Taff (1899, p. 437) when he observed that "there are five principal sandstone beds, which have different thicknesses, from nearly 50 to 200 feet." Hendricks (1937, p. 17) referred to "two large bands" of Savanna sandstone in the McAlester area, but later said that "for convenience in mapping several sandstones separated by thin shales were mapped together as sandstone groups. Over most of the district four such groups were traceable."

Russell (1960, p. 20), in Latimer County, observed that "the Savanna Formation consists predominantly of brown to grayish-green shales with 2 to 14 mappable sandstone units. Generally, the sandstone beds may be grouped into upper and lower groups. Each group contains several sandstone beds separated by shale." It is apparent that the number of sandstone "groups" selected for mapping purposes depends in large part on (1) the topography in the area to be mapped and (2) the scale of mapping.

Hemish and others (1990c), mapping at a scale of 1:24,000, found that seven sandstone "groups" were mappable in the Wilburton 7.5′ quadrangle. These seven ridge-forming groups were mapped eastward in adjacent 7.5′ quadrangles to the Arkansas/Oklahoma line, and informally called the Savanna 1–7 sandstones. (Hemish and others, 1990a,b; Hemish, 1990b; Hemish and Mazengarb, 1992; and Hemish and Suneson, 1993, 1994). Although the units in places split into several beds separated by thin shales, or thin from several beds to just one (or even pinch out for some distance), they were sufficiently persistent and divisible to be mapped at the 1:24,000 scale. Hemish (1992, 1995) continued mapping the seven sandstone units westward from the Wilburton 7.5′ quadrangle, across the Gowen 7.5′ quadrangle, and into the Adamson 7.5′ quadrangle. Future mapping may necessitate modifications in this practice—Hemish was able to distinguish only two mappable ridge-forming units in the Savanna Formation in the north flank of the Sans Bois syncline in southern Haskell County just south of Lequire (in preparation [Geology of the Sans Bois syncline along the proposed route of State Highway 82, Haskell and Latimer Counties, Oklahoma]).

## Principal Reference Section (Neostratotype) for the Savanna Formation

A diagram of the principal reference section for the Savanna Formation, accompanied by a description of each lithologic unit, is presented in the Appendix. Rock-color terms are those shown in the rock-color chart (Rock-Color Chart Committee, 1991). Included in the 1,714.1-ft measured section are 122.5 ft of the upper part of the McAlester Formation; 1,449.1 ft of the Savanna Formation; and 142.5 ft of the lower part of the Boggy Formation.

The location of the measured section is shown in Figure 3. The base of the section begins in the road cut just east of the junction of the section-line road and the road extending ~0.7 mi northwest from Adamson; it covers a distance of slightly more than 1 mi. The section was measured in the road cut east of the curving road, in the road, and in the road cut north of the road near the top of the escarpment. Measurements then were made on one side of the road or the other, in ditches or road cuts, to the knoll in the pasture just east of the road and just south of the iron pasture gate and east-trending trail. Other measurements were made in the road bed and ditch north to the low, covered area. Further measurements were made in the ridge of resistant sandstones in the pasture east of the road in the SW¼SW¼ NW¼ sec. 6, T. 5 N., R. 17 E. Measurements continued from the crest of the ridge northward along the road down to where the road bends sharply west. Measurements were made in the road cut north of the west-trending road to the base of the slope. Measurements were then continued northward from the curve in the road, along the section line between secs. 36, T. 6 N., R. 16 E., and sec. 31, T. 6 N., R. 17 E., down the bluff south of the Buffalo Creek valley, across the valley, and up to the top of the bluff on the north side of the valley. Beds in the area dip north, toward the axis of the Sans Bois syncline, from 33° at the community of Adamson, to 14° on the south flank of Buffalo Mountain, just north of the Buffalo Creek valley (Fig. 3).

In the diagrammatic column (Appendix), the youngest units are listed first (p. 227). These have the highest unit numbers. For example: the upper unit of the Bluejacket Sandstone (the youngest of 64 lithologic units measured) is assigned Unit No. 64. The oldest lithologic unit measured is a shale in the upper part of the McAlester Formation. It appears on the last page of the Appendix, extends from 0–46 ft, and has been assigned Unit No. 1 in the column. Lithologic symbols and sedimentary features are shown in the fourth and fifth columns from the left, respectively. Descriptions of each unit, as well as stratigraphic divisions, are shown in the right-hand column. The mappable sandstones of the Savanna Formation are designated Psv1–7, from lowest (oldest) to highest (youngest); lower-case letters (beginning with "a") identify individual sandstone units in the Savanna sandstones. For example, Psv1a is the lowest sandstone unit in Savanna sandstone 1.

Of the 122.5 ft of the upper part of the McAlester Formation, all but 6.1 ft consists of shale and silty shale with abundant clay-ironstone concretions and layers (Fig. 4). Within the 122.5-ft-thick interval, a 4.8-ft-thick shale unit interbedded with sandstone lenses and an overlying 1.3-ft-thick, massive sandstone bed have been

Figure 4. Silty shale containing abundant clay-ironstone discoidal concretions and layers. Upper part of the McAlester Formation, Unit 1. Geologic pick is 1.1 ft long. Exposed in road cut near base of slope. (NW¼SW¼NW¼SW¼ sec. 6, T. 5 N., R. 17 E.)

interpreted as the Keota Sandstone Member of the McAlester Formation. The top of this sandstone is 70.4 ft below the McAlester/Savanna contact.

Figure 5 shows the basal contact of the Savanna Formation. The exposure shows minor erosion at the top of the McAlester Formation with an irregular contact between Psv1a and the underlying shale.

Figures 6, 7, 8, and 9 show exposures of the other five sandstone units (Psv1b–e) that form Psv1. The total thickness of Psv1 is 75.7 ft, including the interstratified shales.

Separating Psv1 from Psv2 is 44.8 ft of sandy, silty shale, including a 2.3-ft-thick, impure fossiliferous limestone bed (Jolly Limestone of Morgan [1924]?) (Fig. 10). Psv2 comprises four sandstone units and three shale units, totaling 35.1 ft in thickness. Figure 11 shows outcrops of Psv2a and Psv2b. Note the irregular contact with underlying shale in both.

Separating Psv2 from Psv3 is 155.1 ft of shale containing ironstone stringers. Psv3 consists of six sandstone units, none of which exceeds 9 ft in thickness. The sandstone units are separated by five shale units (including a covered interval), most considerably thicker than 9 ft. The total thickness of Psv3, including shale units, is 128.3 ft. Figure 12 shows the flaggy, parallel-bedded character of Psv3c, as well as channeling at the base of the unit. Fossil plant casts are common in Psv3d and Psv3e.

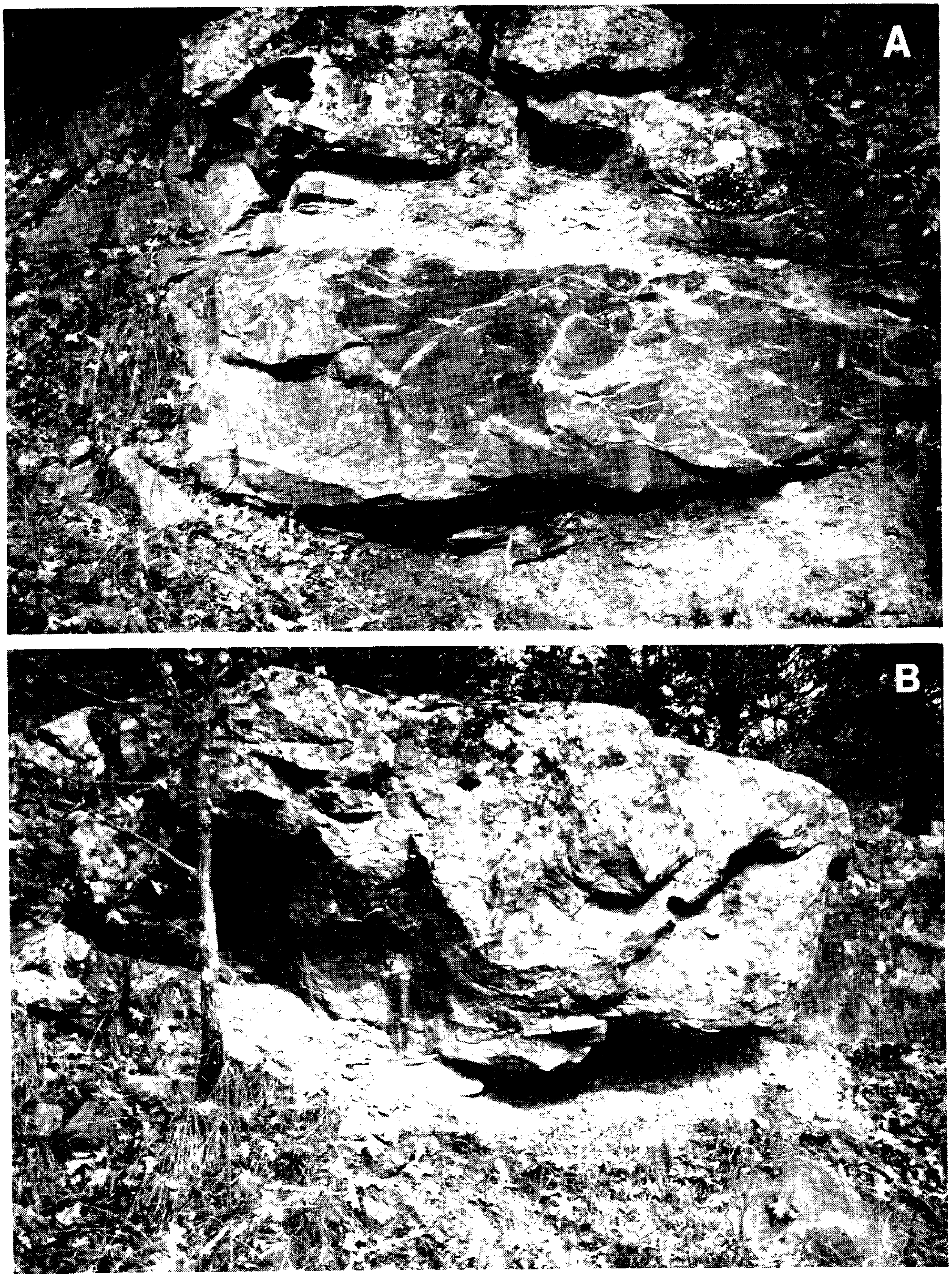



Figure 5. *A*—Contact between McAlester Formation and Savanna Formation. Geologic pick marks a minor erosional channel in shale at the top of Unit 4. *B*—Irregular contact between the McAlester Formation and Savanna Formation (marked by pick). Note the soft-sediment deformation in Psv1a (Unit 5). Geologic pick is 1.1 ft long. Exposed just east of road at top of thick shale unit. (NE¼SE¼NE¼SE¼ sec. 1, T. 5 N., R. 16 E.)

Shale and siltstone beds 135.3 ft thick separate Psv3 from Psv4. Psv4 comprises three sandstone units separated by a shale unit (partly covered) and a sandy shale unit. Total thickness of Psv4, including shale units, is 40.3 ft. Figure 13 shows a large, rolled sandstone mass that is typical of the sedimentary structures found in Psv4a.

An extensive covered area, 174.4 ft thick, obscures part of the Savanna Formation between Psv4 and Psv5. The covered area is topographically low and is assumed to be underlain by shale.

Stratigraphically above the covered area, 105.1 ft of ironstone-bearing, silty shale is exposed in the ditch east of the road just below Psv5. Psv5 is exposed magnificently on the high ridge in the pasture east of the section-line road. (For permission to enter the pasture to examine the outcrops, contact Thomas Irwin, Hartshorne, Oklahoma, phone (918) 297-2937.) Figure 14 shows the parallel-bedded character of the lower part of Psv5, which apparently is a single 41.5-ft-thick unit in this area.

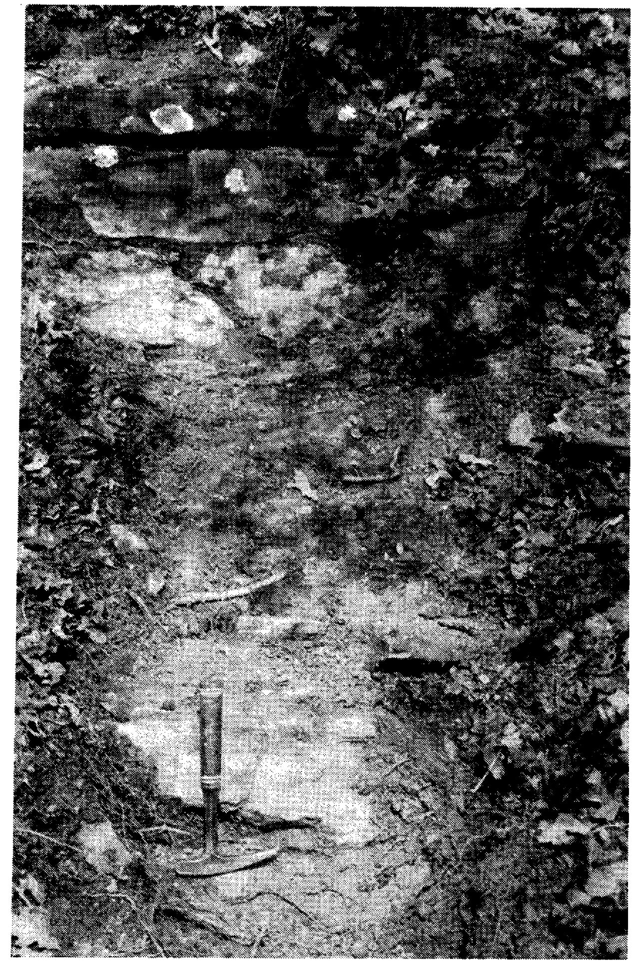


Figure 6. Psv1b sandstone (Unit 7) showing parallel bedding, interbedded sandy shale, and sharp, irregular basal contact (marked by pick head). Exposed in cut east of road. Geologic pick is 1.1 ft long. (SE¼NE¼NE¼ SE¼ sec. 1, T. 5 N., R. 16 E.)

Approximately 30 ft stratigraphically above the top of Psv5, the first sandstone bed in a series of poorly exposed, interbedded sandstones and shales crops out in the road bed downslope north from the ridge crest. This series includes Psv6a and Psv6b along with an intervening 34.9-ft-thick covered interval, and is 117.7 thick.

Part of the 97.1-ft-thick interval between Psv6 and Psv7 is covered, but the shales and siltstones that are exposed have a variety of sedimentary structures. Figure 15 shows concentrically banded flow rolls at the base of Unit 53. Units 54 and 56 are thin, wavy siltstone beds characterized by a proliferation of trace fossils on both the tops and bottoms of each bed. Unit 55 contains an abundance of spindle-shaped pot casts (infillings of eroding vortex flows) (Myrow, 1992) that weather out of the shale and litter the outcrop (Fig. 16).

Psv7 is at least 28.5 ft thick and is exposed in the steep bluff on the south side of Buffalo Creek valley. It is a ferruginous, thick-bedded, blocky unit, well exposed only at the top of the bluff. The lowermost bed is exposed at the contact with alluvium at the edge of the flood plain of Buffalo Creek.

The lower 207 ft of the thick shale interval at the top of the Savanna Formation is buried under the alluvium in Buffalo Creek valley. Exposures of this part of the for-

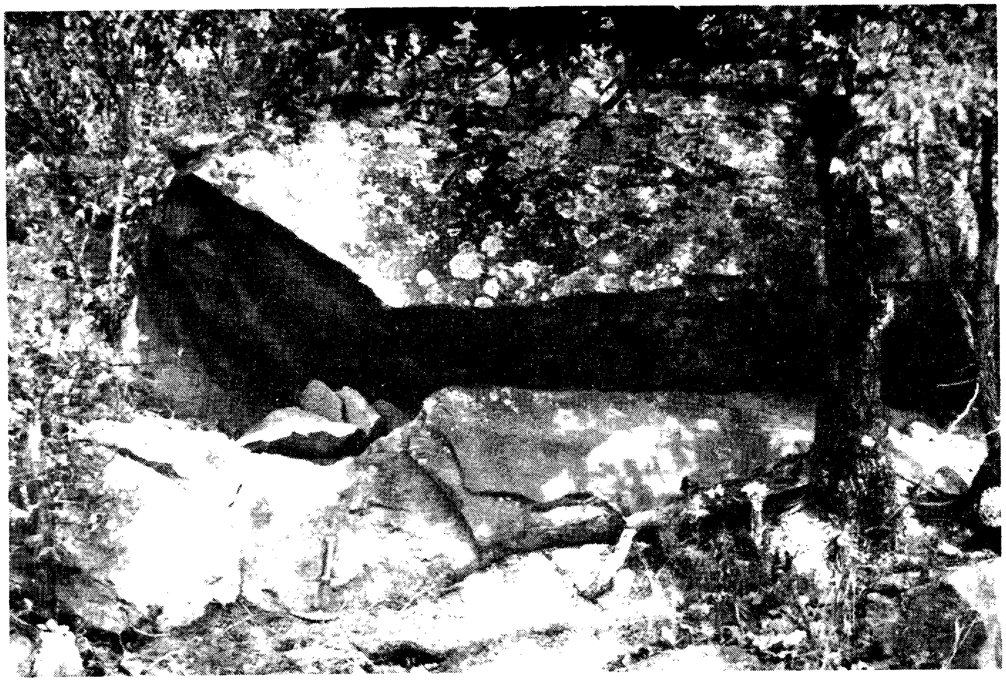


Figure 7. Psv1c sandstone (Unit 9) showing massive, blocky character of the unit. Pick head marks the sharp, irregular basal contact. Geologic pick is 1.1 ft long. Exposed at east edge of road near sharp bend to the east. (SE¼NE¼NE¼SE¼ sec. 1, T. 5 N., R. 16 E.)

mation are rare because the shale is nonresistant to erosion, and streams typically follow the topographically low, strike-oriented valleys underlain by the shale. However, 33.3 ft of lenticular-bedded, silty, sandy shale in the upper part of the Savanna Formation is well exposed at the base of the Bluejacket Sandstone escarpment on the north side of Buffalo Creek valley (Appendix, Units 60, 61).

The contact between the Savanna Formation and the overlying Boggy Formation is at the base of Unit 62, the lower sandstone unit of the Bluejacket Sandstone Member.

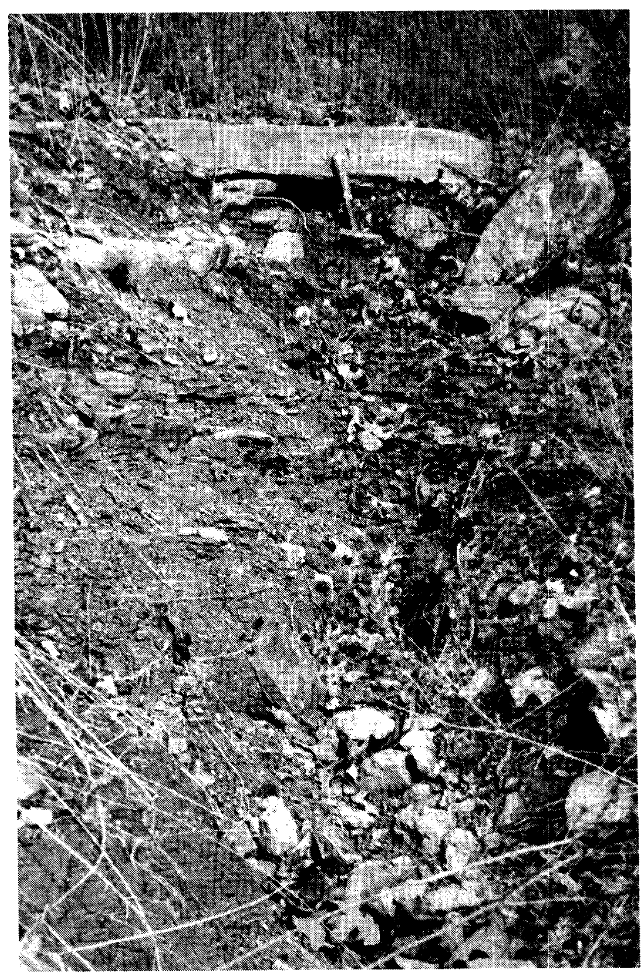


Figure 8 (right). Psv1d sandstone (Unit 11) and underlying silty, sandy shale with ironstone concretions (Unit 10) exposed in ditch where road curves sharply east. Pick marks a zone of flow rolls at the contact between Units 10 and 11. Geologic pick is 1.1 ft long. (SE¼NE¼NE¼SE¼ sec. 1, T. 5 N., R. 16 E.)


Figure 9. *A*—Psv1e sandstone (Unit 13) exposed in road cut, north side of sharp eastward bend in road. Sandstone is silty and parallel bedded. Geologic pick is 1.1 ft long. *B*—Close-up view of Unit 13 showing parallel bedding and bioturbation features (indicated by arrow, upper left of photograph). Geologic pick is 1.1 ft long. (SE¼NE¼NE¼SE¼ sec. 1, T. 5 N., R. 16 E.)

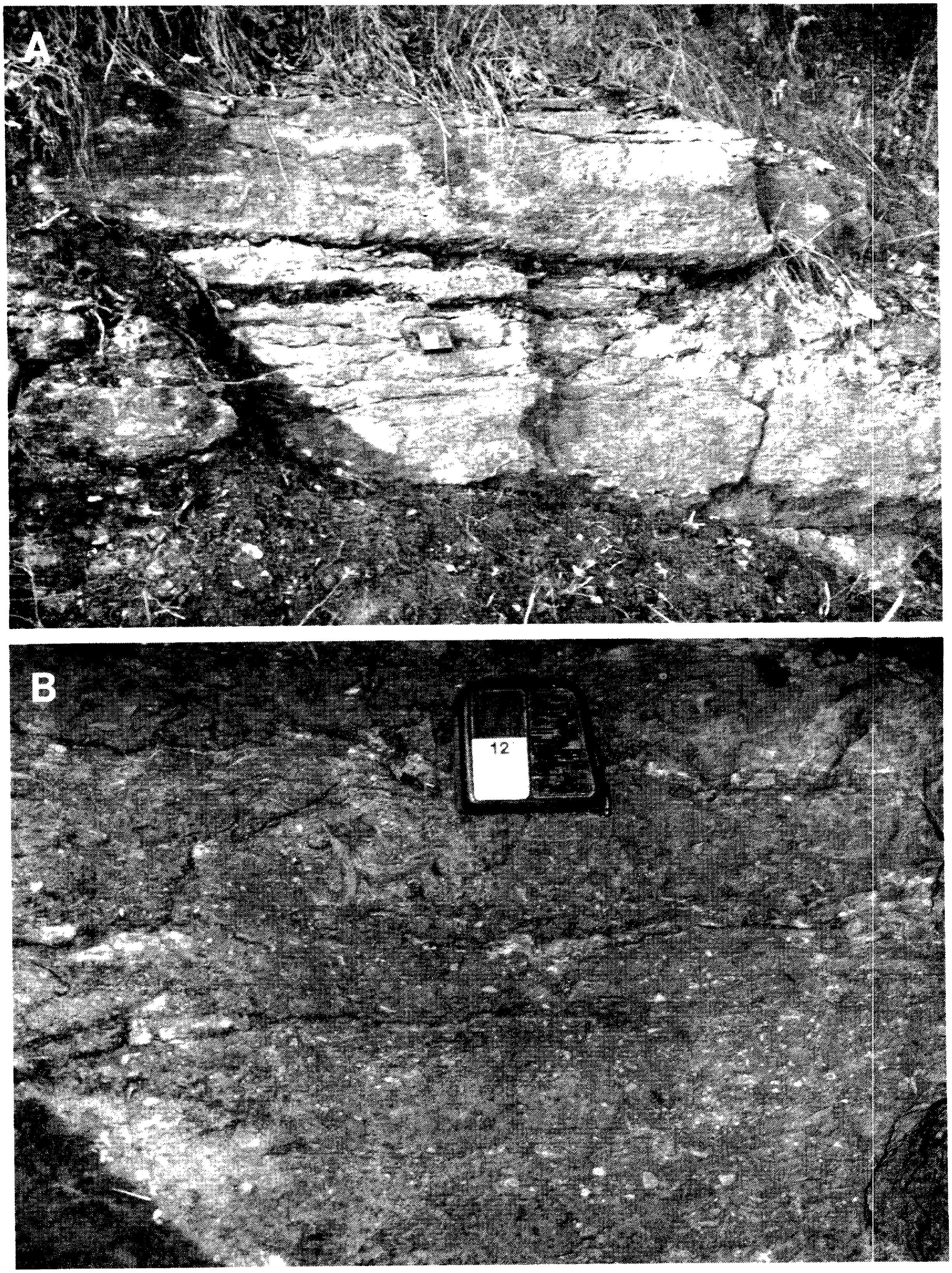



Figure 10. *A*—Impure sandy and silty limestone (Unit 15) exposed in road cut, north side of road, just up from sharp eastward bend. *B*—Close-up view of Unit 15, showing the fossiliferous character of the limestone. Tape measure case is 2 in. wide. (SE¼NE¼NE¼ SE¼ sec. 1, T. 5 N., R. 16 E.)

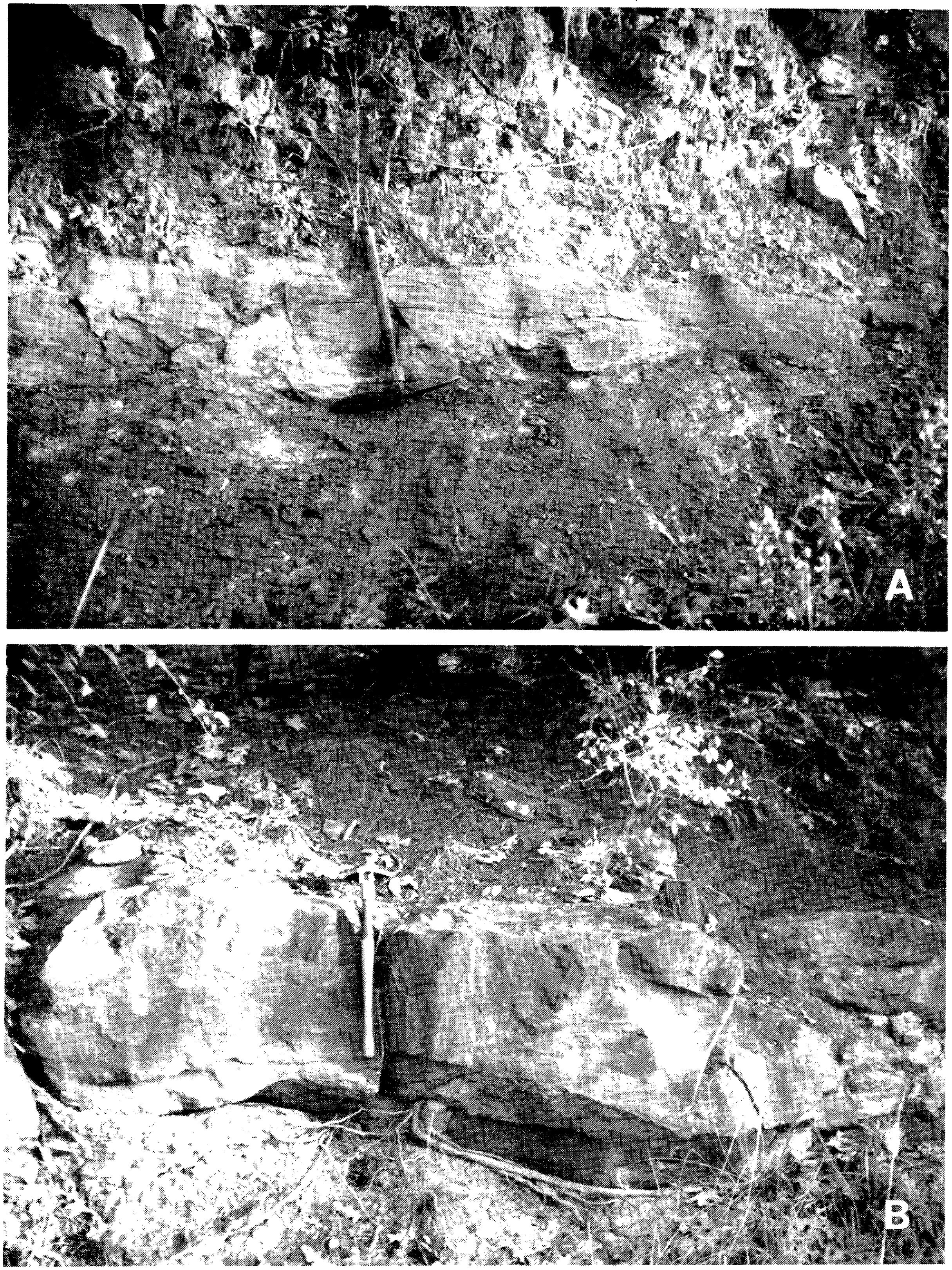



Figure 11. *A*—Psv2a sandstone (Unit 17) enclosed in shale, showing sharp irregular upper and lower boundaries. Note swaly bedded character. *B*—Psv2b sandstone (Unit 19) showing blocky, thick-bedded character and sharp, irregular boundaries. Trenching tool is 1.7 ft long. Exposed in road cut north of road just before road bends to the north. (SE¼ NE¼NE¼SE¼ sec. 1, T. 5 N., R. 16 E.)

Figure 12. Psv3c sandstone (Unit 30), exposed in road cut at crest of first high ridge north of bend (to the north) in road. Note thin to medium, parallel-bedding, and minor erosional channel (arrow) at top of underlying shale (Unit 29). Trenching tool is 1.7 ft long. (SE¼ SE¼SE¼NE¼ sec. 1, T. 5 N., R. 16 E.)

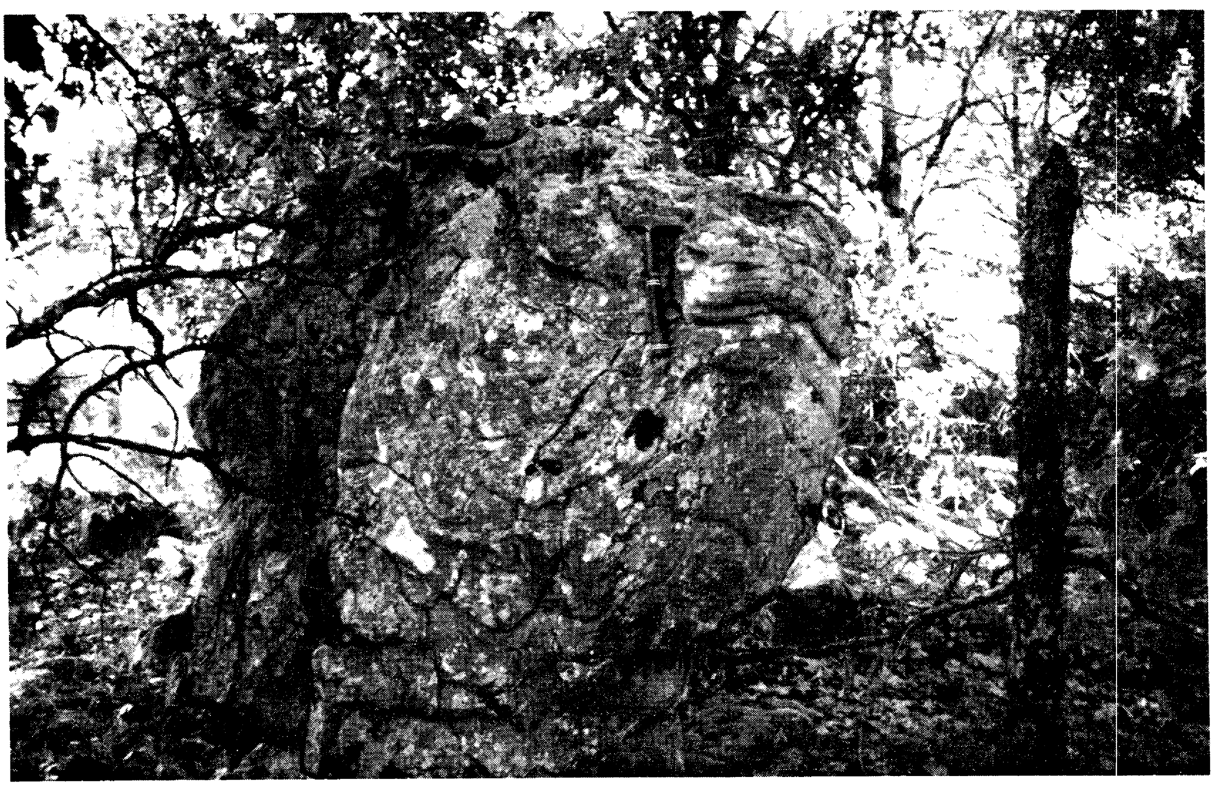


Figure 13. Large, rolled sandstone mass (Psv4a sandstone, Unit 39) exposed just east of road in pasture on low ridge. Soft-sediment deformation is common in this unit. Geologic pick is 1.1 ft long. (SW¼NW¼SW¼NW¼ sec. 6, T. 5 N., R. 17 E.)

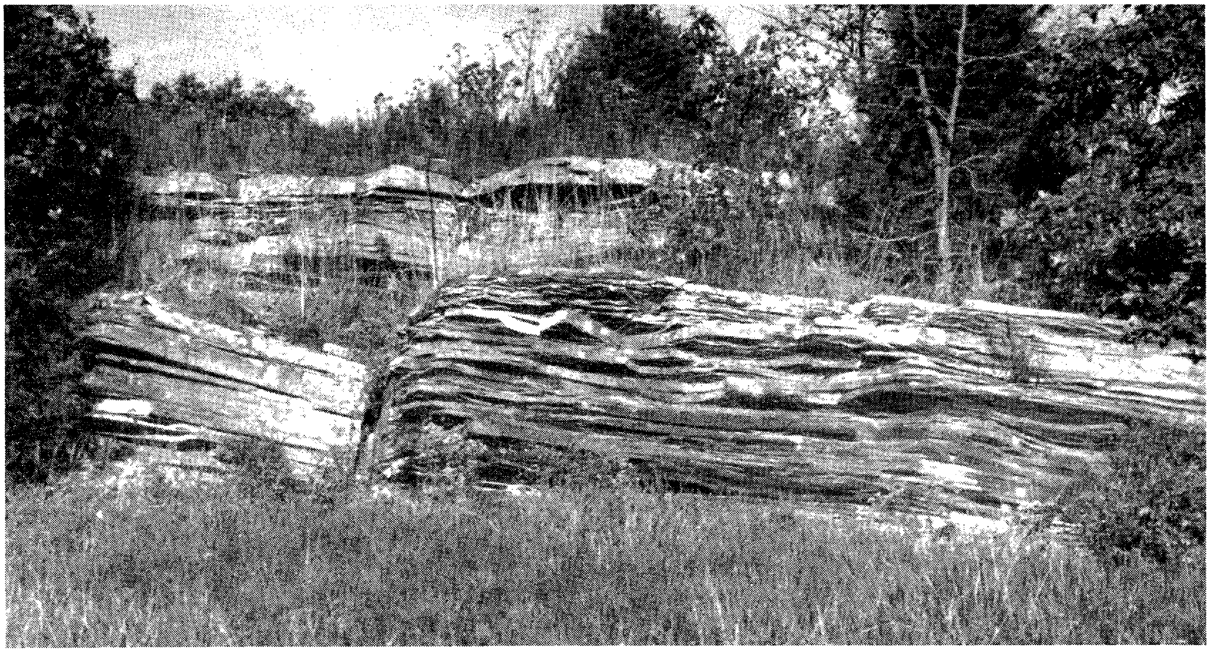


Figure 14. Flat, parallel-bedded, lower part of Psv5 sandstone (Unit 47) exposed in pasture near base of high ridge ~0.1 mi east of road. Total thickness of strata shown is ~15 ft. (SE¼SW¼NW¼NW¼ sec. 6, T. 5 N., R. 17 E.) *Please note:* For permission to enter the pasture to examine the outcrops, contact Thomas Irwin, Hartshorne, Oklahoma, phone (918) 297-2937.

Figure 15. Concentrically layered sandstone masses (flow rolls) in silty shale (Unit 53) exposed in road ditch ~0.1 mi west of right-angle bend in road. Tape measure case is 2 in. wide. (SW¼SE¼SE¼SE¼ sec. 36, T. 6 N., R. 16 E.)

Figure 16. Spindle-shaped pot casts weathering out of shale (Unit 55) in road-cut exposure on north side of road ~0.05 mi west of right-angle bend in road. Brunton compass is ~3 in. wide. (SE¼SE¼SE¼SE¼ sec. 36, T. 6 N., R. 16 E.)

The contact is somewhat gradational; it occurs in a sequence of strata that coarsens upward and changes in lithology from predominantly shale to predominantly sandstone (Fig. 17).

Strata 92.0 ft thick are covered between the 24.0-ft-thick lower unit of the Bluejacket Sandstone and the 26.5-ft-thick upper unit of the Bluejacket Sandstone (Fig. 18). The Bluejacket exposed at the top of the bluff is coarser grained than the underlying sandstones of the Savanna Formation. It contains large-scale trough cross-bedding as well as numerous soft-sediment deformation features.

## Summary

The name originally assigned to the Savanna Formation by Taff (1899, p. 437) was the "Savanna sandstone." He did note that in the series of sandstones and shales comprising the formation, "the shaly beds combined are probably thicker than the sandstones." He felt that because the sandstones were better exposed and because they formed such prominent ridges, "sandstone" seemed a more appropriate term.

However, calculations made by combining the thicknesses of all the sandstone units measured in the Savanna in the Adamson section (neostratotype) show that

Figure 17. Contact between Savanna Formation and Boggy Formation (indicated by arrow). Top beds in the Savanna (Unit 61) comprise silty shale and lenses of very fine grained sandstone. The overlying lower unit of the Bluejacket Sandstone (Unit 62) contains flaggy, wavy-bedded, very fine grained sandstone. Contact is exposed in small gully, part way up the bluff north of Buffalo Creek valley. (SE¼SE¼NE¼SE¼ sec. 36, T. 6 N., R. 16 E.)

their total thickness is only 232.9 ft. The total thickness of the Savanna Formation at this location is 1,449.1 ft. Simple calculations reveal that only 16% of the formation is actually sandstone.

The percentage of sandstone in the Savanna probably increases eastward, but it definitely diminishes northward as the formation thins, and in places in the shelf area (in Mayes County [Hemish, 1990a, core-hole 7, appendix]) the percentage of sandstone is only 2.4%.

Interpretations of the depositional environments of the various units in the Savanna Formation have not been presented in this paper. My overall impression is that the formation was deposited primarily in a large delta complex with intermittent shallow marine influence. The abundance of flow rolls and other soft-sediment deformation features that typify most of the Savanna sandstone units suggests rapid, periodic sedimentation on oversteepened depositional slopes, and sediment failure that occurred after deposition.

Establishing this principal reference section creates a framework for future workers who may wish to expand the study or to collect samples and do petrographic work. Detailed studies would increase our understanding of the sedimentology of the Savanna Formation. (Appendix starts on p. 226.)

Figure 18. Cross-bedded, deformed upper unit of Bluejacket Sandstone Member of Boggy Formation (Unit 64) exposed at top of bluff on the north side of Buffalo Creek valley. (NW¼SW¼NW¼SW¼ sec. 31, T. 6 N., R. 17 E.)

## References Cited


Dane, C. H.; and Hendricks, T. A., 1936, Correlation of the Bluejacket Sandstone, Oklahoma: American Association of Petroleum Geologists Bulletin, v. 20, p. 312–314.

Dane, C. H.; Rothrock, H. E.; and Williams, J. S., 1938, The Quinton-Scipio district, Pittsburg, Haskell, and Latimer Counties, *pt. 3 of* Geology and fuel resources of the southern part of the Oklahoma coalfield: U.S. Geological Survey Bulletin 874-D, p. 151–254.

Hemish, L. A., 1990a, Lithostratigraphy and core-drilling, upper Atoka Formation through lower Senora Formation (Pennsylvanian), northeastern Oklahoma shelf area: Oklahoma Geological Survey Special Publication 90-2, 54 p.

______1990b, Trough cross-bedding in sandstone of the Savanna Formation: Oklahoma Geology Notes, v. 50, p. 65–66.

______1991a, Fossil linguoid ripple marks in sandstone of the Savanna Formation: Oklahoma Geology Notes, v. 51, p. 117–118, 155.

______1991b, Geologic map of the Leflore quadrangle, Latimer and Le Flore Counties, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

______1992, Geologic map of the Gowen quadrangle, Latimer County, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

______1993, Spaniard(?) and Sam Creek(?) Limestones in Le Flore County, Oklahoma: Oklahoma Geology Notes, v. 53, p. 84–111.

______1994, Correlation of the Lower Witteville coal bed in the Arkoma basin, eastern Oklahoma: Oklahoma Geology Notes, v. 54, p. 4–28.

______1995, Geologic map of the Adamson quadrangle, Latimer and Pittsburg Counties, Oklahoma: Oklahoma Geological Survey STATEMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

Hemish, L. A.; and Mazengarb, Colin, 1992, Geologic map of the Summerfield quadrangle, Le Flore County, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

Hemish, L. A.; and Suneson, N. H., 1993, Geologic map of the Wister quadrangle, Le Flore County, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

______1994, Geologic map of the Heavener/Bates quadrangles, Le Flore County, Oklahoma: Oklahoma Geological Survey STATEMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

Hemish, L. A.; Suneson, N. H.; and Ferguson, C. A., 1990a, Geologic map of the Panola quadrangle, Latimer County, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

______1990b, Geologic map of the Red Oak quadrangle, Latimer County, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

______1990c, Geologic map of the Wilburton quadrangle, Latimer County, Oklahoma: Oklahoma Geological Survey COGEOMAP Geologic Quadrangle Map, 1 sheet, scale 1:24,000.

Hendricks, T. A., 1937, The McAlester district, Pittsburg, Atoka, and Latimer Counties, *pt. 1 of* Geology and fuel resources of the southern part of the Oklahoma coalfield: U.S. Geological Survey Bulletin 874-A, p. 1–90.

______1939, The Howe-Wilburton district, Latimer and Le Flore Counties, *pt. 4 of* Geology and fuel resources of the southern part of the Oklahoma coalfield: U.S. Geological Survey Bulletin 874-D, p. 255–300.

Knechtel, M. M., 1937, The Lehigh district, Coal, Atoka, and Pittsburg Counties, *pt. 2 of* Geology and fuel resources of the southern part of the Oklahoma coalfield: U.S. Geological Survey Bulletin 874-B, p. 91–150.

______1949, Geology and coal and natural gas resources of northern Le Flore County, Oklahoma: Oklahoma Geological Survey Bulletin 68, 76 p.

Miser, H. D., 1954, Geologic map of Oklahoma: Oklahoma Geological Survey and U.S. Geological Survey, 2 sheets, scale 1:500,000.

Morgan, G. D., 1924, Geology of the Stonewall quadrangle, Oklahoma: [Oklahoma] Bureau of Geology Bulletin 2, 248 p.

Myrow, P. M., 1992, Pot and gutter casts from Chapel Island Formation, southeast Newfoundland: Journal of Sedimentary Petrology, v. 62, p. 992–1007.

North American Commission on Stratigraphic Nomenclature, 1983, North American stratigraphic code: American Association of Petroleum Geologists Bulletin, v. 67, p. 841–875.

Oakes, M. C.; and Knechtel, M. M., 1948, Geology and mineral resources of Haskell County, Oklahoma: Oklahoma Geological Survey Bulletin 67, 134 p.

Rock-Color Chart Committee, 1991, Rock-color chart: Distributed by the Geological Society of America, Boulder, Colorado.

Russell, D. T., 1960, Geology of northern Latimer County, Oklahoma: Oklahoma Geological Survey Circular 50, 57 p.

Snider, L. C., 1914, Geology of east-central Oklahoma: Oklahoma Geological Survey Bulletin 17, 25 p.

Taff, J. A., 1899, Geology of the McAlester-Lehigh coalfield, Indian Territory: U.S. Geological Survey 19th Annual Report, pt. 3, p. 437–438.

Taff, J. A.; and Adams, G. I., 1900, Geology of the eastern Choctaw coalfield, Indian Territory: U.S. Geological Survey 21st Annual Report, pt. 2, p. 257–311.

Vanderpool, R. E., 1960, Geology of the Featherston area, Pittsburg County, Oklahoma: Oklahoma Geological Survey Circular 53, 36 p.

Webb, P. K., 1960, Geology of the Cavanal syncline, Le Flore County, Oklahoma: Oklahoma Geological Survey Circular 51, 65 p.
Wilson, C. W., Jr., 1935, Age and correlation of Pennsylvanian surface formations and of oil and gas sands of Muskogee County, Oklahoma: American Association of Petroleum Geologists Bulletin, v. 19, p. 503–520.
Wilson, C. W., Jr.; and Newell, N. D., 1937, Geology of the Muskogee-Porum district, Muskogee and McIntosh Counties, Oklahoma: Oklahoma Geological Survey Bulletin 57, 184 p.

*(See next page for Appendix.)*

## Soft-Sediment Deformation *(continued from p. 202)*


Theories put forward by Potter and Pettijohn (1977, p. 228) suggest that convolute bedding results from vertical transfer of material—some kind of internal readjustment of water-saturated sand. Collinson (1994, p. 102) states that "convolute bedding records the internal foundering of liquefied sediment layers upon themselves, commonly in conjunction with active upward escape of pore water."

Inset photo B shows a large rolled and contorted sandstone mass, also part of the basal sandstone unit of the Savanna Formation. This type of soft-sediment deformation probably results from slumping following rapid deposition on an oversteepened slope. Allen (1977) suggests that in many cases liquefaction and loss of strength are spontaneous consequences of the early postdepositional state of the sediment layer. Deformation might be triggered by an external agent, such as an earthquake, or by heavy wave action on shallowly submerged aqueous bed forms.

Soft-sediment deformation is common in many of the sandstone units of the Savanna Formation throughout the Arkoma basin, which indicates a rapid influx of fine-grained material that was convoluted while in a quicksand state.

### References Cited

Allen, J. R. L., 1977, The possible mechanics of convolute lamination in graded sand beds: Journal of the Geological Society, v. 134, p. 19–31.
Collinson, John, 1994, Sedimentary deformational structures, *in* Maltman, Alex (ed.), The geological deformation of sediments: Chapman & Hall, London, p. 95–125.
Pettijohn, F. J.; Potter, P. E.; and Siever, Raymond, 1987, Sand and sandstone [2nd edition]: Springer-Verlag, New York, 553 p.
Potter, P. E.; and Pettijohn, F. J., 1977, Paleocurrents and basin analysis [2nd edition]: Springer-Verlag, New York, 425 p.

*LeRoy A. Hemish*

# APPENDIX: Neostratotype of Savanna Formation

## Measured Section Pi-1-94-H — Adamson 7.5′ Quadrangle

Measured along section-line road and route of power line between sec. 1, T. 5 N., R. 16 E., and sec. 6, T. 5 N., R. 17 E.; and between sec. 36, T. 6 N., R. 16 E., and sec. 31, T. 6 N., R. 17 E., Pittsburg County, Oklahoma; starting at the base of the slope at the road intersection ~0.5 mi northwest of Adamson, and ending at the top of the bluff just north of the flood plain of Buffalo Creek. Section measured perpendicular to east–west strike of beds by LeRoy A. Hemish, October 25–26, 1994.

### Explanation

Sandstone

Sandstone, shaly

Sandstone, silty

Siltstone

Shale

Shale, sandy

Shale, silty

Limestone, sandy, silty

Covered interval

### Sedimentary Features

Trough cross-stratification

Low-angle cross-stratification

Parallel stratification

Wavy bedding

Nodular bedding

Lenticular bedding

Climbing ripples

Current lineation

Swaly bedding

Convolute bedding

Slumped or contorted bedding

Ripple marks

Flow rolls

Load structures

Scour-and-fill

Dewatering feature

Groove cast

Pot cast

M Micaceous

Calcareous

Ironstone band

Ironstone concretion

Fissile

Plant stem

Comminuted plant material

F Fossils (invertebrate)

Brachiopod

Crinoid debris

Bivalve

Bioturbated

Vertical burrow

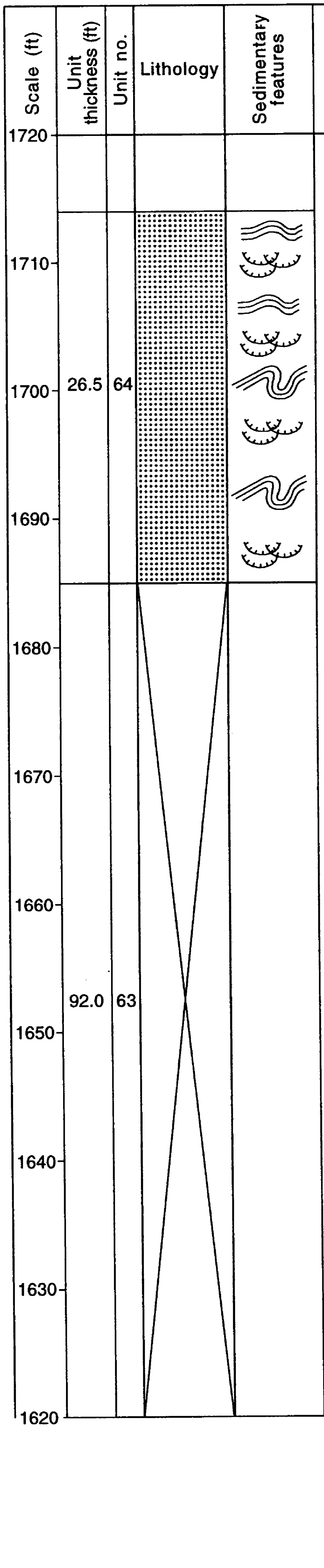
Horizontal burrow

Fining-upward sequence

Coarsening-upward sequence

# APPENDIX: Neostratotype of Savanna Formation

## Measured Section Pi-1-94-H — Adamson 7.5′ Quadrangle




Description of units

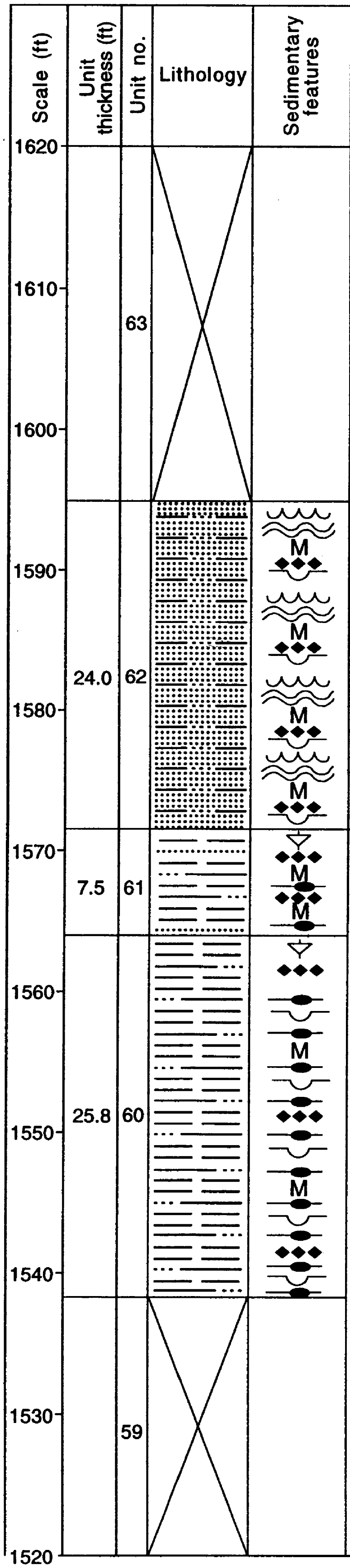
**KREBS GROUP**

**Boggy Formation**

*Bluejacket Sandstone Member:*

64. Sandstone, moderate orange pink (5YR8/4), weathers light brown (5YR6/4) to grayish orange pink (5YR7/2), fine-grained, medium- to thick-bedded, large-scale trough cross-bedded; includes some soft-sediment deformation features; base sharp; entire sequence shows a stacked-channel relationship (upper unit, Bluejacket Sandstone).

63. Covered interval.




Description of units

62. Sandstone, grayish orange (10YR7/4), very fine grained, silty, shaly, micaceous, very thin to thin-bedded; wavy, parallel-bedded, ripple-marked; black, comminuted plant material on stratification surfaces; trace fossils on soles of beds; basal contact somewhat gradational, but readily defined by change in lithology from predominantly shale to predominantly sandstone (lower unit, Bluejacket Sandstone).

**Savanna Formation**

61. Shale, moderate yellowish brown (10YR5/4), silty; contains small lenses of very fine grained, micaceous sandstone with black comminuted plant material on stratification surfaces; coarsens upward; base gradational.

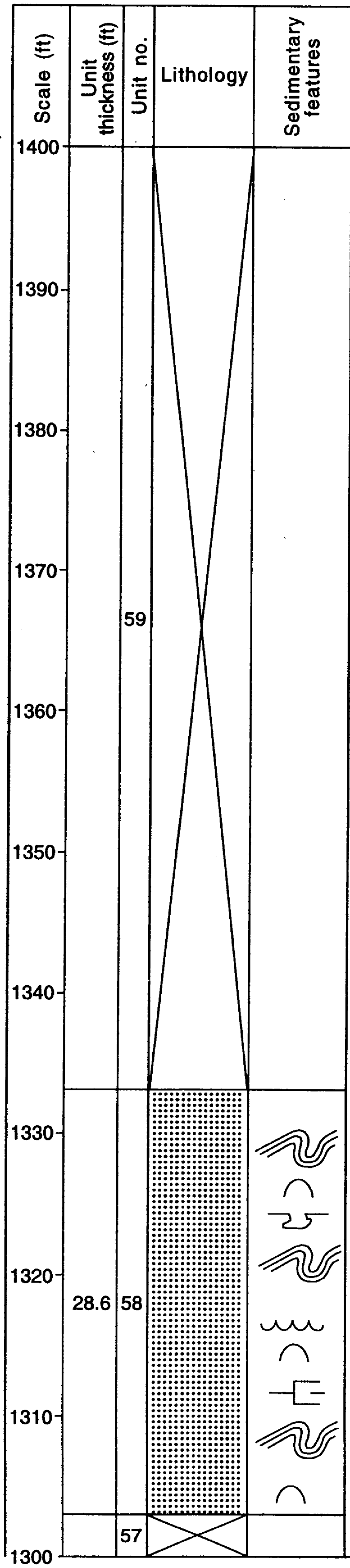
60. Shale, olive gray (5Y3/2), weathers yellowish gray (5Y7/2), silty; siltstone laminae are lenticular, micaceous, and have black, carbonized, comminuted plant material on bedding surfaces; unit contains burrows as much as 1 in. long and 0.3 in. in diameter; coarsens upward; base gradational.

# APPENDIX: Neostratotype of Savanna Formation
*(continued)*

| Scale (ft) | Unit thickness (ft) | Unit no. | Lithology | Sedimentary features | Description of units |
|---|---|---|---|---|---|
| 1520 | | | | | |
| 1510 | | | | | |
| 1500 | | | | | |
| | 207.0 | 59 | | | 59. Covered interval (alluvium in Buffalo Creek Valley). |
| 1490 | | | | | |
| 1480 | | | | | |
| 1470 | | | | | |
| | 30 feet of unit 59 omitted | | | | |
| 1440 | | | | | |
| 1430 | | | | | |
| 1420 | | 59 | | | |
| 1410 | | | | | |
| 1400 | | | | | |

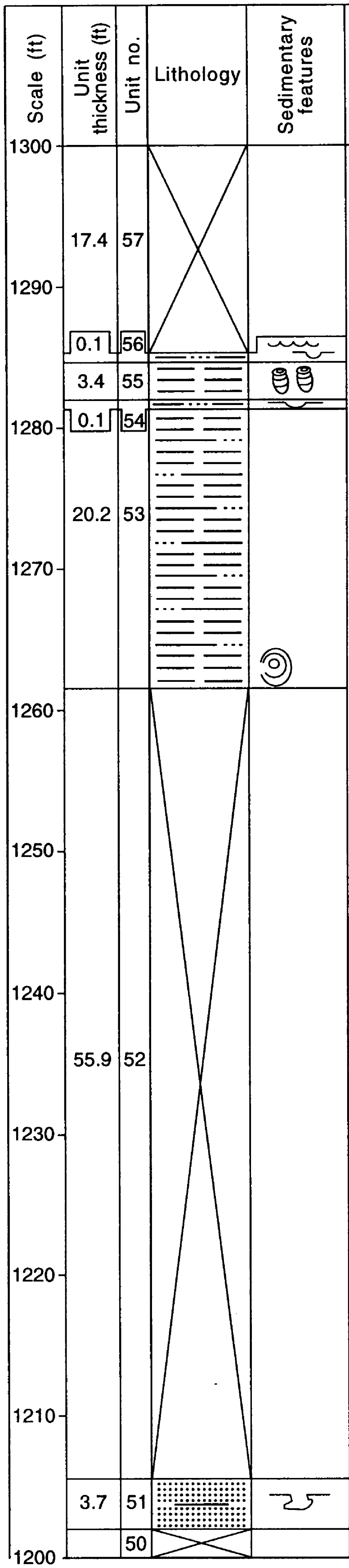
# APPENDIX: Neostratotype of Savanna Formation

*(continued)*




Description of units

58. Sandstone, grayish red (5R4/2), weathers very dusky red (10R2/2), ferruginous, very fine grained, thick-bedded, some swaly beds, blocky; many beds show soft-sediment deformation features; exposed mostly as float in steep dip slope south side of Buffalo Creek; some load casts and grooves on overturned float blocks; in situ exposure of sandstone part way down slope is ripple marked; upper part (top?) of unit is exposed at contact with alluvium at edge of flood plain of Buffalo Creek (Psv7).




Description of units

57. Covered interval (from top of bluff, south side of Buffalo Creek, to fence where road turns west).

56. Siltstone, light olive gray (5Y5/2) weathers light brown (5YR5/6), thin-bedded, ripple-marked; includes trace fossils in abundance on both top and bottom of bed; exposed on north side of bend-to-the-west in road and in road cut further west. This unit and three underlying units exposed in sloping road cut, north side of west-trending road.

55. Shale, dark yellowish orange (10YR6/6), weathers grayish orange (10YR7/4); contains an abundance of spindle-shaped pot casts mostly ~3 in. long and 1–2 in. in diameter, but some much larger; base sharp.

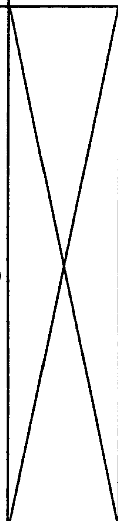
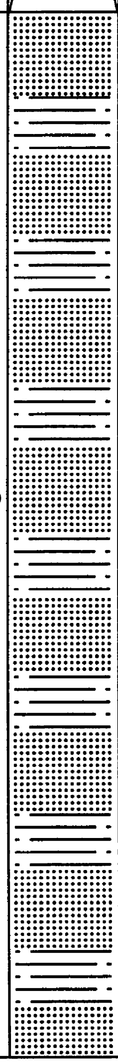
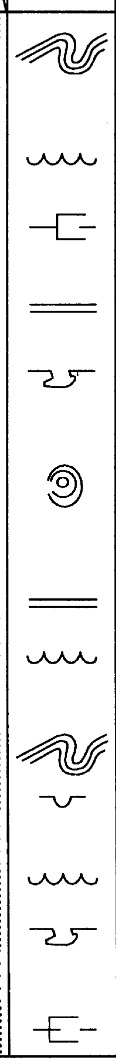
54. Siltstone, dark yellowish brown (10YR4/2) to light olive gray (5Y5/2), weathers dark yellowish orange (10YR6/6) and light brown (5YR5/6), thin-bedded, somewhat wavy-bedded; characterized by a proliferation of trace fossils of many kinds on both top and bottom of bed; base sharp.

53. Shale, light olive gray (5Y5/2), weathers dark yellowish orange (10YR6/6) to yellowish gray (5Y7/2); contains siltstone stringers and sandstone lenses; near base of exposure, contains rounded, elongate, flattened, ellipsoidal, light brown (5YR5/6), very fine grained sandstone masses (flow rolls); unit has a banded appearance; base covered.

52. Covered interval.

51. Sandstone, light olive gray (5Y5/2), weathers moderate brown (5YR4/4), very fine grained, shaly, thin- to medium-bedded, irregular-bedded, load casts on some soles, poorly exposed in road bed (Psv6b).

# APPENDIX: Neostratotype of Savanna Formation
*(continued)*

| Scale (ft) | Unit thickness (ft) | Unit no. | Lithology | Sedimentary features | Description of units |
|---|---|---|---|---|---|
| 1200–1167 | 34.9 | 50 |  | | 50. Covered interval. |
| 1167–1100 | 79.1 | 49 |  |  | 49. Sandstone, light olive gray (5Y5/2), weathers light brown (5YR6/4) to moderate reddish brown (10R4/6), to grayish orange (10YR7/4), interbedded with yellowish gray (5Y7/2) and moderate reddish orange (10R6/6) sandy shale; thin- to medium-bedded; some beds are flat and parallel, some are irregular, others are ripple marked; many beds are deformed, showing convolute structures and flow rolls; many beds have good sole markings, including load casts, grooves, and trace fossils; unit is exposed on dip slope in road bed and in ditch (Psv6a). |

## APPENDIX: Neostratotype of Savanna Formation
### *(continued)*

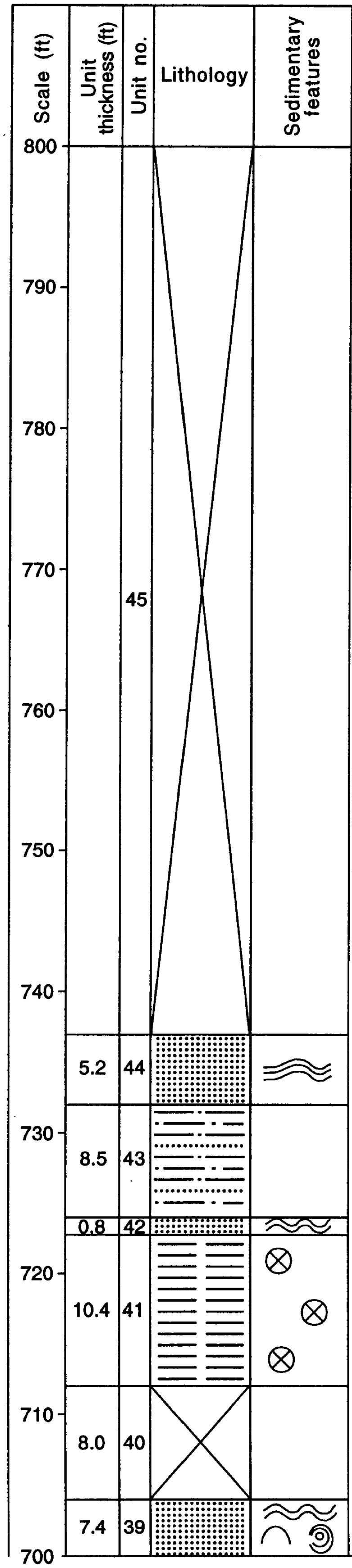
| Scale (ft) | Unit thickness (ft) | Unit no. | Lithology | Sedimentary features | Description of units |
| --- | --- | --- | --- | --- | --- |
| 1100<br>1090 | | 49 | | | |
| 1080<br>1070<br>1060 | 29.8 | 48 | | | 48. Shale, light olive gray (5Y6/1), weathers dusky yellow (5Y6/4), silty; poorly exposed in road ditch, mostly covered. |
| 1050<br>1040<br>1030<br>1020 | 41.5 | 47 | | | 47. Sandstone, grayish orange (10YR7/4) to moderate brown (5YR4/4) with moderate reddish orange (10R6/6) staining in places, very fine to fine-grained, well-sorted and well-rounded, very thin to thin-bedded, platy; mostly flat, parallel-bedded, but in some places contains large-scale, low-angle cross-bedding; some beds internally wavy-laminated, some have symmetrical ripple marks, others have current lineation features; upper part is mostly pale red (5R6/2), thicker bedded, and displays more low-angle cross-bedding features; also shows some channeling relationships in upper part, as well as soft-sediment deformation features.<br>Note: Section was measured along excellent outcrops in pasture, east of road on high ridge. Overturned blocks show numerous sole markings such as load casts and trace fossils in this same area. Base sharp (Psv5). |
| 1010<br>1000 | | 46 | | | |

| Scale (ft) | Unit thickness (ft) | Unit no. | Lithology | Sedimentary features | Description of units |
|---|---|---|---|---|---|
| 1000 | 105.1 | 46 | | | 46. Shale, light olive gray (5Y5/2), weathers grayish orange (10YR7/4), silty; contains small, light brown (5YR5/6), discoidal clay-ironstone concretions. |
| 990 | | | | | |
| 980 | | | | | |
| 970 | | | | | |
| 960 | | | | | |
| 950 | | | | | |
| 940 | | | | | |
| 930 | | | | | |
| 920 | | | | | |
| 910 | | 45 | | | |
| 900 | | | | | |

# APPENDIX: Neostratotype of Savanna Formation
## *(continued)*

| Scale (ft) | Unit thickness (ft) | Unit no. | Lithology | Sedimentary features | Description of units |
|---|---|---|---|---|---|
| 900 | | | | | |
| 890 | | | | | |
| 880 | | | | | |
| 870 | | | | | |
| 860 | | | | | |
| | 174.4 | 45 | | | 45. Covered interval. |
| 850 | | | | | |
| 840 | | | | | |
| 830 | | | | | |
| 820 | | | | | |
| 810 | | | | | |
| 800 | | | | | |

# APPENDIX: Neostratotype of Savanna Formation
*(continued)*




Description of units

44. Sandstone, yellowish gray (5Y7/2), very fine grained, thick-bedded; exposed surface has a hummocky, "wrinkled," and pitted appearance, poorly exposed in road bed and ditch (Psv4c).

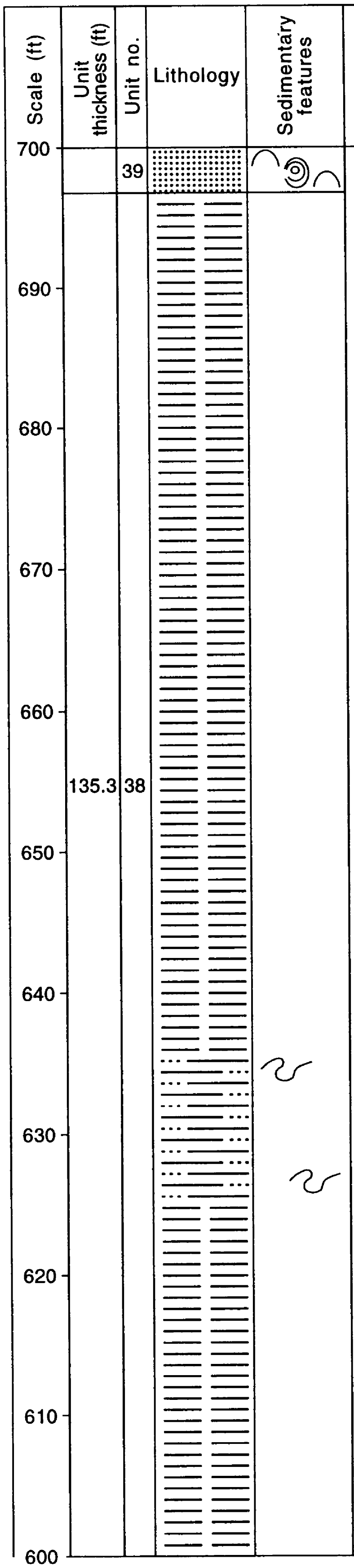
43. Shale, light gray (N7), weathers dusky yellow (5Y6/4), very sandy; contains scattered, very fine grained sandstone stringers, base sharp.

42. Sandstone, grayish orange (10YR7/4), very fine grained, thin-bedded, obscurely wavy-bedded, base sharp (Psv4b).

41. Shale, light olive gray (5Y5/2) with light brown (5YR5/6) staining; contains small moderate reddish brown (10R4/6) and light brown (5YR5/6) clay-ironstone concretions; base covered.

40. Covered interval.

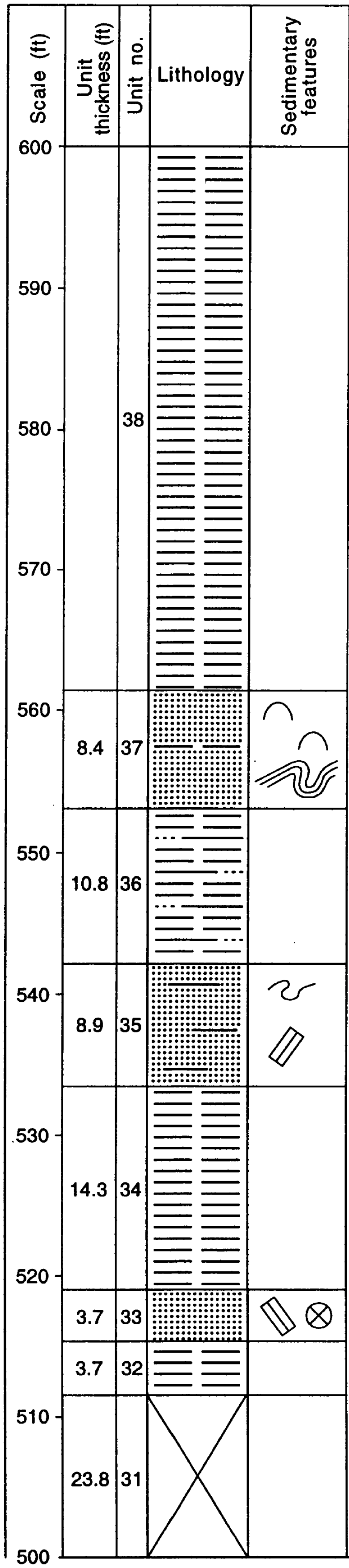
39. Sandstone, grayish orange pink (5YR7/2) to various hues of brown, such as light brown (5YR6/4), pale brown (5YR5/2), and moderate brown (5YR3/4, 5YR4/4); very fine grained; mostly massive; some swaly beds; large flow rolls and other soft-sediment deformation features characterize the unit; well-exposed in pasture just east of road (Psv4a).




Description of units

38. Shale, pale yellowish brown (10YR6/2) to grayish orange (10YR7/4) and very pale orange (10YR8/2); includes some thin-bedded, pale yellowish brown (10YR6/2), moderately bioturbated siltstone beds in middle part of unit; most of interval is poorly exposed or covered.

# APPENDIX: Neostratotype of Savanna Formation
***(continued)***




Description of units

37. Sandstone, grayish orange (10YR7/4), dark yellowish orange (10YR6/6), and very pale orange (10YR8/2), very fine grained, irregularly medium bedded; includes some thin swaly beds, soft-sediment deformation features common; includes a 1-ft-thick shale bed in middle of unit; base sharp (Psv3f).

36. Shale, light olive brown (5Y5/6), silty, weathers light olive gray (5Y5/2), poorly exposed in east road ditch.

35. Sandstone, grayish orange (10YR7/4), very fine grained, thin-bedded, bioturbated; contains fossil plant casts; interbedded with dusky yellow (5Y6/4) shale; breaks into small, irregular-shaped blocks; base gradational (Psv3e).

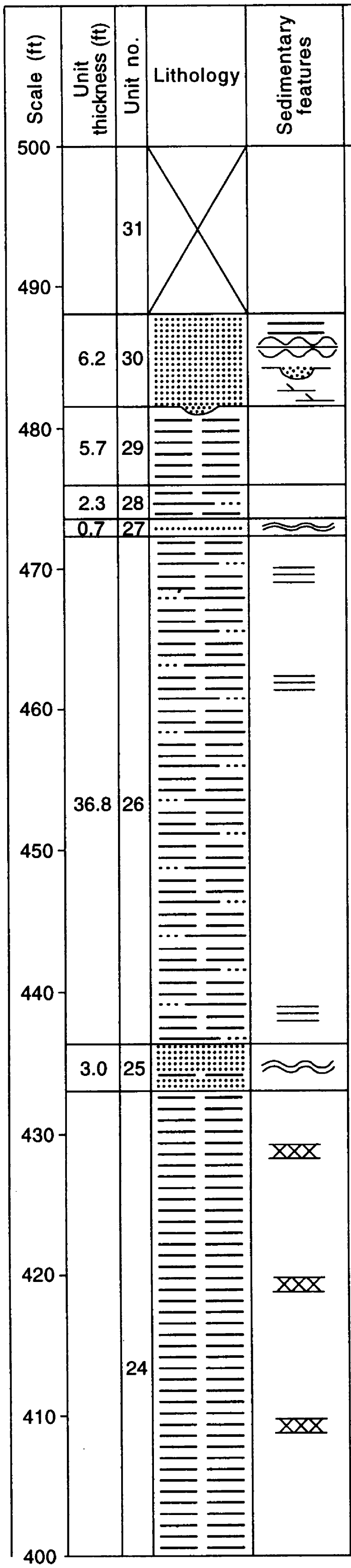
34. Shale, light olive gray (5Y5/2), weathers dark yellowish orange (10YR6/6); poorly exposed in ditch east of road, base sharp.

33. Sandstone, grayish yellow (5Y8/4) to grayish orange (10YR7/4), weathers light brown (5YR5/6), very fine grained, thick- to medium-bedded, irregular-bedded; contains fossil plant casts and a thin discontinuous layer of ironstone pebbles; poorly exposed in road bed and ditch (Psv3d).

32. Shale, olive gray (5Y4/1), weathers grayish orange (10YR7/4); base covered.

31. Covered interval.

## APPENDIX: Neostratotype of Savanna Formation *(continued)*




Description of units

30. Sandstone, grayish orange (10YR7/4), weathers moderate yellowish brown (10YR5/4), very fine grained, thin- to medium-bedded at top of unit; cut-and-fill near base, with low-angle cross-bedding; other beds flat and parallel with current lineation features; well-exposed at crest of high ridge; base sharp; channels into underlying shale (Psv3c).

29. Shale, light gray (N7), weathers grayish orange (10YR7/4) and dark yellowish orange (10YR6/6), base gradational.

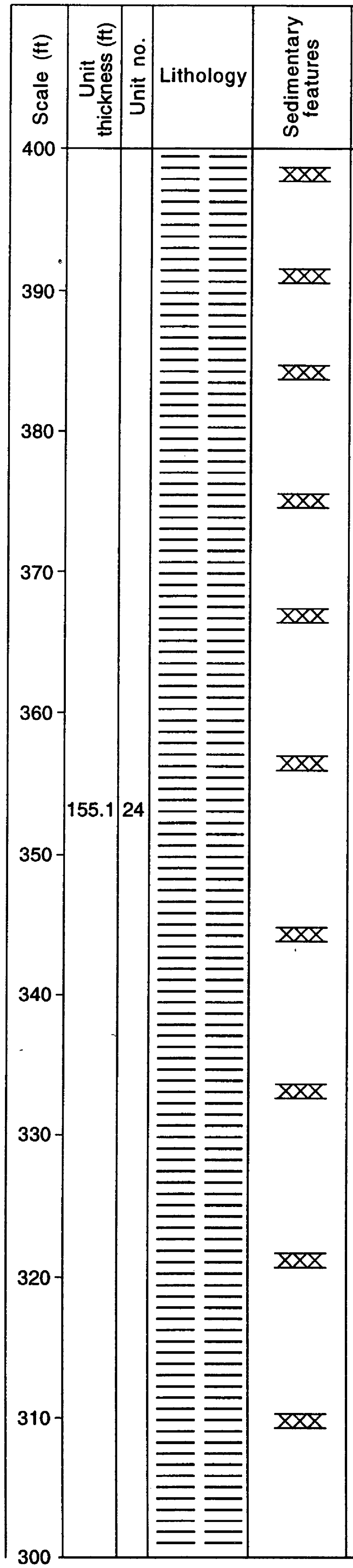
28. Shale interbedded with siltstone, dark yellowish orange (10YR6/6), weathers grayish orange (10YR7/4), blocky, base gradational.

27. Sandstone, moderate yellowish brown (10YR5/4) to grayish orange (10YR7/4), very fine grained, silty, thin-bedded, obscurely wavy bedded, base sharp (Psv3b).

26. Shale, olive gray (5Y4/1), weathers pale yellowish brown (10YR6/2), silty, breaks into small flakes on the outcrop; includes some light olive gray (5Y5/2) siltstone layers as much as 0.6 ft thick.

25. Sandstone, moderate olive brown (5Y4/4), weathers light olive gray (5Y5/2), very fine grained, thin-bedded, interbedded with shale in lower part, obscurely wavy laminated; basal contact exposed in ditch, east side of road; top part medium-bedded, blocky; base sharp (Psv3a).

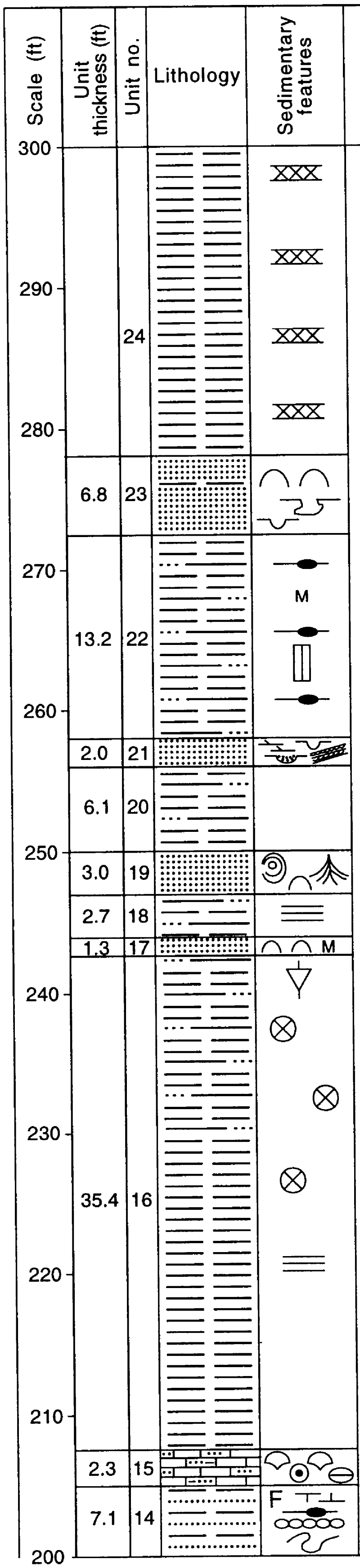
# APPENDIX: Neostratotype of Savanna Formation
*(continued)*




Description of units

24. Shale, olive gray (5Y4/1) with dark yellowish orange mottling; contains thin, light brown (5YR5/6) clay-ironstone stringers; poorly, intermittently exposed in road ditches; mostly covered.

## APPENDIX: Neostratotype of Savanna Formation
### *(continued)*




Description of units

23. Sandstone, dusky yellow (5Y6/4) with light brown (5YR5/6) and dark yellowish orange (10YR6/6) staining, very fine grained, irregularly thick to medium bedded, blocky, swaly bedded in places; overturned beds in pasture have trace fossils and load structures on some soles; a 5-ft-thick, mottled, light olive gray (5Y5/2) and grayish orange (10YR7/4) clayey shale layer is present ~2.5 ft below top of unit; exposed where road turns north along section line (Psv2d).

22. Shale, moderate olive brown (5Y4/4) interbedded with siltstone stringers and lenses of the same color, micaceous; siltstones include rare, finely ribbed plant casts in growth position.

21. Sandstone, grayish orange (10YR7/4), weathers moderate yellowish brown (10YR5/4), very fine grained, shaly, micaceous, thin-bedded; contains low-angle cross-laminations, climbing ripples, and scour-and-fill features; trace fossils on bedding soles; top and base gradational (Psv2c).

20. Shale, light olive brown (5Y5/6), weathers grayish orange (10YR7/4), silty, blocky, base sharp.

19. Sandstone, yellowish gray (5Y7/2) to light olive gray (5Y5/2), weathers moderate brown (5YR3/4, 5YR4/4), very fine grained, thick-bedded, blocky; contains flow rolls, dewatering structures, and swaly beds, base sharp and irregular (Psv2b).

18. Shale, light olive gray (5Y5/2) silty, brittle, base sharp.

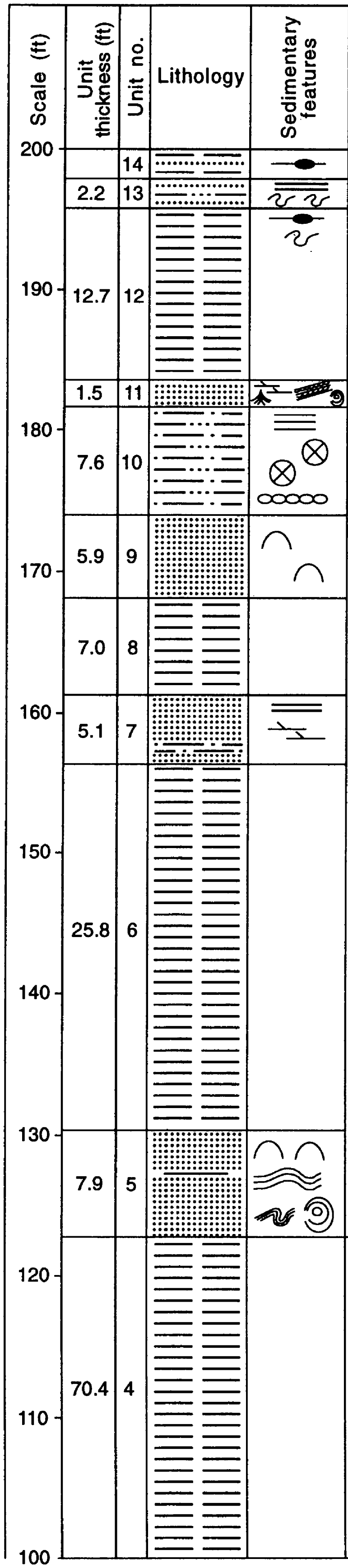
17. Sandstone, dusky yellow (5Y6/4) to light olive gray (5Y5/2), weathers pale yellowish brown (10YR6/2) with grayish brown (5YR3/2) staining, very fine grained, micaceous, medium-bedded, contains low-amplitude swaly bedding, base sharp and curved (Psv2a).

16. Shale, olive gray (5Y3/2), variegated grayish red (5R4/2) and yellowish gray (5Y5/2) in part; weathers to small brittle flakes; well-exposed in road cut, contains small, dark yellowish orange (10YR6/6) clay-ironstone concretions in upper part; becomes increasingly silty upwards.

15. Limestone, moderate yellowish brown (10YR5/4), weathers moderate brown (5YR3/4, 5YR4/4); very impure, silty and sandy; abundantly fossiliferous—contains crinoid ossicles, brachiopods, and bivalves as much as 2 in. long and 1.5 in. wide; includes some thin shale partings, base sharp.

14. Shale interbedded with nodular-bedded, lensing sandstone, grayish orange (10YR7/4) to moderate yellowish orange (10YR5/4) to moderate brown (5YR4/4); shale is silty and blocky; sandstone is very fine grained and noncalcareous in lower part of unit, but very calcareous and sparsely fossiliferous in upper part; bioturbated; base sharp.

## APPENDIX: Neostratotype of Savanna Formation
### *(continued)*




**Description of units**

13. Sandstone, dusky yellow (5Y6/4) to light olive gray (5Y5/2), weathers moderate yellowish brown (10YR5/4), very fine grained, silty, thin- to medium-bedded, parallel-bedded; strongly bioturbated; similar in appearance to limestone ~7 ft above, but is noncalcareous; base sharp (Psv1e).

12. Shale, light olive gray (5Y5/2), weathers moderate yellowish brown (10YR5/4); contains lenses of bioturbated sandstone in upper 1 ft of unit; base sharp.

11. Sandstone, pale yellowish brown (10YR6/2) to light olive gray (5Y5/2) with dark yellowish orange (10YR6/6) and light brown (5YR5/6) staining; very fine grained, medium-bedded; upper part contains low-angle cross-stratification, climbing ripples, and small-scale dewatering features; basal part consists of rolled, pillow-like, sandstone masses (flow rolls) extending downward into underlying shale with sharp but irregular contact (Psv1d).

10. Shale, dark yellowish brown (10YR4/2) to light olive gray (5Y5/2), silty and sandy, fissile, nodular bedded in places; contains scattered, small, ironstone concretions, base sharp; well-exposed in ditch at curve in road.

9. Sandstone, grayish orange (10YR7/4), weathers moderate brown (5YR4/4), very fine grained, massive, blocky; includes some low-amplitude, swaly beds in places; base sharp, irregular (Psv1c).

8. Shale, light olive gray (5Y5/2), weathers yellowish gray (5Y7/2) with dark yellowish orange (10YR6/6) mottling, highly weathered, poorly exposed.

7. Sandstone, grayish yellow (5Y8/4) to dusky yellow (5Y6/4), weathers moderate brown (5YR3/4), very fine grained; medium-bedded, parallel-bedded; contains obscure, low-angle cross-stratification; unit includes a 1.5-ft-thick, light olive gray (5Y5/2) sandy shale layer ~1.3 ft from bottom; basal contact sharp and irregular (Psv1b).

6. Shale, light olive gray (5Y5/2), weathers yellowish gray (5Y7/2), highly weathered, poorly exposed.

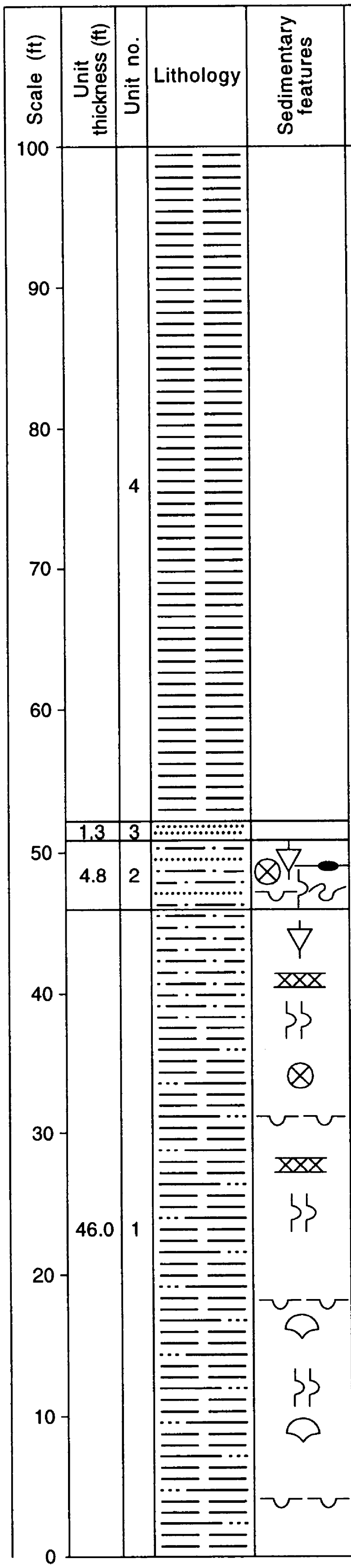
5. Sandstone, grayish orange (10YR7/4), light brown (5YR5/6), and moderate brown (5YR3/4, 5YR4/4), very fine grained, massive; soft-sediment deformation features common, such as convolute beds, ball structures, and swaly beds; includes minor shale interbeds in places; basal contact sharp, irregular and disconformable, unit fills shallow channels in underlying shale (Psv1a).

Note: Total thickness of Savanna Formation is 1449.1 ft.

**McAlester Formation**

4. Shale, yellowish gray (5Y7/2) to moderate yellowish brown (10YR5/4) weathered, intermittently exposed—interval mostly covered except for upper 4 ft, which is mottled light brown (5YR5/6), moderate reddish brown (10R4/6), and yellowish gray (5Y7/2).

## APPENDIX: Neostratotype of Savanna Formation
### *(continued)*




Description of units

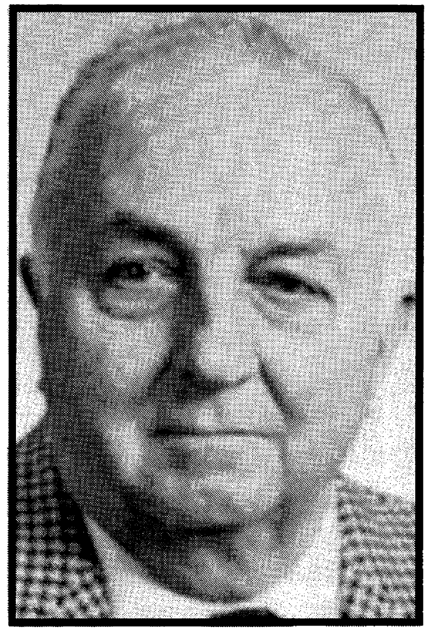
*Keota Sandstone Member:*

3. Sandstone, grayish orange (10YR7/4), very fine grained, thick-bedded, massive; poorly exposed in road bed and in ditch west of road; appears to be slumped in ditch, base sharp.

*Keota Sandstone Member:*

2. Shale interbedded with very fine grained lenticular sandstone, light olive gray (5Y5/2), weathers moderate yellowish brown (10YR5/4) and moderate brown (5YR3/4), stained dusky yellowish brown (10YR2/2) by manganese oxide; moderately bioturbated, fossil burrows abundant; contains some dark reddish brown (10R3/4) ironstone concretions; becomes increasingly sandy upwards.

1. Shale, olive gray (5Y4/1), weathers grayish orange (10YR7/4) to moderate yellowish brown (10YR5/4), silty; contains leached, ferruginous, brachiopod-rich, very fine grained sandstone lenses 2–3 in. thick in lower part of unit; also contains siltstone-filled burrows about 0.25–0.5 in. in diameter, generally on bedding planes, but also cutting across stratification; in upper part includes discoidal, dark reddish brown (10R3/4) to light brown (5YR5/6) clay-ironstone concretions ~0.6 in. in diameter and 1–2 in. thick, as well as clay-ironstone layers ~1 in. thick; becomes sandy upwards and grades into overlying unit; base of unit covered.



*Arthur J. Myers*
**(1918–1995)**

*In Memoriam*

## ARTHUR J. MYERS
*Retired OGS Geologist*

Arthur J. Myers, a former Oklahoma Geological Survey geologist and professor in the OU School of Geology and Geophysics, passed away this fall in Norman. Myers is remembered fondly by former colleagues and students for his 33 years of devoted service to the OGS and to the University of Oklahoma.

Born in South Haven, Michigan, in 1918, Myers earned two bachelor's degrees, a master's, and a doctorate in Michigan. He was an officer in the U.S. Navy during World War II, and after the war served in the Navy Reserves until 1965.

Myers came to the University of Oklahoma as an assistant professor of geology in 1951. He was named associate professor in 1961 and professor of geology and geophysics in 1973. For many summers he taught the OU geology field camps. He earned a reputation among students and faculty as an outstanding teacher.

In 1978, Myers left the OU School of Geology and Geophysics to work full time at the OGS. He served as a geomorphologist and aerial-photo interpreter, and also reviewed all OGS maps before publication. He earned the appreciation of his OGS co-workers for his meticulous, thorough work.

Myers' publications for the OGS include Bulletin 80—*Geology of Harper County, Oklahoma,* Guidebook 15—*Guide to Alabaster Cavern and Woodward County, Oklahoma,* and numerous articles in *Oklahoma Geology Notes.*

He also contributed to other OGS publications, including Guidebook 22—*Guide to Robbers Cave State Park.*

Myers retired from the OGS in 1984. Besides spending time at his hobbies of gardening and creating heirloom-quality rugs and needlepoint pillows, Myers continued to take an interest in the activities of the OGS. He will be missed by many friends, colleagues, and family members.

## *Former Associates Remember Art Myers*

"He enjoyed teaching and it showed. Many alumni who took beginning geology as an elective science rarely remember the names of their teachers. Not so with those who took a course from Dr. Myers. They remember him foldly, and even remember some of the geology he taught them. No greater tribute can be bestowed on a college professor than to be remembered fondly by students. Dr. Myers earned that tribute through 27 years of effective teaching at the University of Oklahoma."

—Charles J. Mankin
*OGS Director*

"Dr. Myers, as he liked to be called, was a very private person. He was prompt and precise. He had his own way of doing things. His life ran on a strict schedule that kept a rhythm and a purpose after he retired, allowing him to remain vigorous even when his health began to fail, and letting him accomplish many things in his last years. His needlepoint projects and hooked rugs proceeded on a specific number of rows each day and he created these 'works of Art' for as long as possible. His collections of stamps and art objects were added to until the time of his death, his birds were fed by him or a friend, and his correspondence continued. His flowers continued to thrive, and many plants flourished in the greenhouse that he had built pane by pane."

—Paula Hewitt
*Retired OGS Print Shop Manager*
and
Connie Smith
*OGS Promotion and Information Specialist*

"I regret very much the passing of Art Myers. The lessons I learned in his 'Advanced Geomorphology and Areal Photography' class in 1975 are helping me even today. He was one of the few professors willing to be in on a good 'joke' around the department. We were always playing pranks on each other—and he had some really good ideas!

"He was, however, a real taskmaster. His tests and finals were legendary! However, if you made it out of one of his classes with an A, you really knew your stuff. I thank 'Uncle Art' (as I called him) for leaving many wonderful memories in a small group of students and professors that were friends, not adversaries. I'll always see him on Friday afternoons in the back courtyard of Gould Hall, having a Coke and eating the hamburgers we cooked up and sold for Sigma Gamma Epsilon to make rock kits—smiling, joking, and eating!"

—Deborah Sacrey
*Geologist*

# OGS Geologist Receives Three Awards

Samuel A. Friedman, senior coal geologist with the Oklahoma Geological Survey, received the Distinguished Alumnus Award from Brooklyn College (CUNY) during its 70th annual commencement on June 1.

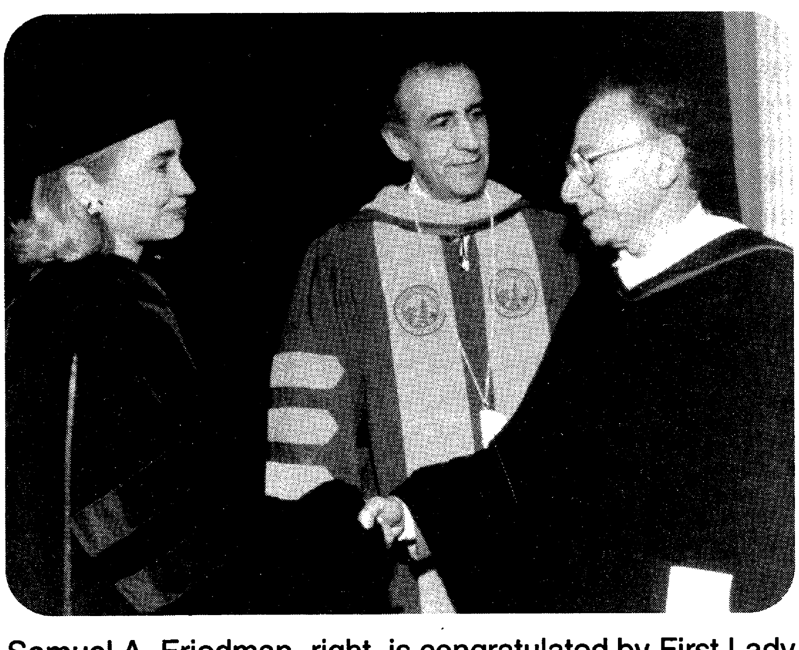
Brooklyn College president Vernon E. Lattin presented Friedman with the medal and certificate "in recognition of his extensive contributions to the science and literature of geology, and of his generous commitment to the advancement of his profession."

The Distinguished Alumnus Award was the third honor Friedman received during the 1994–95 fiscal year for his contributions to the field of geology.

In September 1994, Friedman received the Gordon H. Wood, Jr., Memorial Award of the Eastern Section of AAPG. He was given a plaque at the AAPG Eastern Section annual meeting at Michigan State University, East Lansing, Michigan, "in recognition of and appreciation for his dedicated, thoughtful, and quality approach to leadership in coal science and love for the goals of the Energy Minerals Division within the Eastern Section and elsewhere."

On March 1, Friedman received the Distinguished Service Award of the American Association of Petroleum Geologists (AAPG), "in recognition of and appreciation for his dedicated, thoughtful, and quality excellence in geology and his lifelong service to AAPG." The plaque was presented by AAPG president A. T. (Toby) Carlton at the group's annual meeting in Houston, Texas.

Friedman has held several offices within the AAPG Energy Minerals Division (EMD), and served as president in 1990–91. He currently is chair of the EMD Coal Committee and the Liaison Committee, and is associate editor for coal for the AAPG *Bulletin.*



Samuel A. Friedman, right, is congratulated by First Lady Hillary Rodham Clinton after receiving the Distinguished Alumnus Award from Brooklyn College (CUNY). The award was presented by Brooklyn College President Vernon E. Lattin, center, at the June commencement ceremonies, where Clinton was keynote speaker.

A Fellow of the Geological Society of America (GSA) since 1964, Friedman was chair of the GSA Coal Geology Division in 1977 and received the division's Distinguished Service Award in 1992.

Friedman was hired by the OGS in July 1971 to establish and conduct a program of coal investigations in Oklahoma. This program has led to numerous publications and presentations by Friedman and fellow coal geologist LeRoy A. Hemish on the distribution of Oklahoma's coal resources and minable reserves, and mined out areas of low, medium, and high sulfur coal deposits.

# GSA South-Central Section Annual Meeting
# Austin, Texas ★ March 11–12, 1996

The Department of Geological Sciences at the University of Texas at Austin will host the 30th annual meeting of the South-Central Section of the Geological Society of America. The meeting will be held on campus, during spring break week.

The following agenda is planned:

## Symposia

NAGT Symposium—Planetary Geology in Geological Education
Records Preserved in Carbonate Rocks: Cycles, Ocean Chemistry, Sedimentation, and Diagenesis
Caribbean Tectonics
High-Resolution Analysis of Coastal Processes and Geomorphic Change
Fractured Aquifers and Petroleum Reservoirs
Invertebrate Paleontology of the South-Central Region
Karst Hydrogeology
Late Cretaceous–Early Tertiary Stratigraphy and Paleontology in Northeastern Mexico
Origin and Evolution of the Ouachita Embayment
Precambrian Evolution of the Southwestern Laurentian Continent
Principles and Practice of Hydrogeology
Restructuring Geoscience Education for the 21st Century
Ronald K. DeFord Symposium on the Stratigraphy and Structure of Trans-Pecos Texas
Tertiary Tectonics of the South-Central Region
Unsaturated Zone Hydrology
Vertebrate Paleontology of the South-Central Region
Quaternary Geology and Paleoenvironments
Biological Tools for Water Quality and Hydrologic Assessment

## Field Trips

Precambrian Geology of the Eastern Llano Uplift, Central Texas
Quaternary Alluvial Deposits of the Colorado River, Texas Gulf Coastal Plain
Cretaceous Cyclic Platform Carbonates of Central Texas
Edwards Aquifer, Central Texas
Late Cretaceous/Early Tertiary Stratigraphy of Northeast Mexico

For further information about the meeting, contact Mark Cloos, Department of Geological Sciences, University of Texas, Austin, TX 78712; (512) 471-4170; fax 512-471-9425; E-mail: cloos@maestro.geo.utexas.edu. *The preregistration deadline is February 9.*

THE GEOLOGICAL SOCIETY OF AMERICA · 1888 ·

# PLATFORM CARBONATES — A WORKSHOP
## Oklahoma City, Oklahoma, March 26–27, 1996

"Platform Carbonates in the Southern Midcontinent," a two-day workshop co-sponsored by the Oklahoma Geological Survey and the Bartlesville Project Office of the U.S. Department of Energy, will be held in the Clarion Hotel/Comfort Inn Conference Center at 4345 N. Lincoln Boulevard in Oklahoma City.

This is the ninth annual workshop designed to transfer technical information that will aid in the search for, and production of, our oil and gas resources. Platform carbonates are limestone and and dolomites deposited in a shallow-marine, platform (or shelf) environment. These carbonates have already yielded large volumes of oil and gas, and they have great potential for yielding additional hydrocarbons by the use of improved exploration and development techniques.

The preliminary program for talks and posters is listed below:

### *Oral Presentations*

**Petroleum Production from Platform Carbonates of Oklahoma**, by G. Carlyle Hinshaw, Kenneth S. Johnson, and Robert A. Northcutt

**Distribution and Geometries of Platform-Carbonate Reservoirs—Insight from Modern Counterparts in the Bahamas**, by G. Michael Grammer and Robert N. Ginsberg

**The Initiation of Carbonate Sedimentation in the Southern Oklahoma Aulacogen: Part 1**, by R. Nowell Donovan

**Depositional and Diagenetic Controls on Porosity Development in the Ordovician Viola Formation, South-Central Kansas**, by K. David Newell

**Grain-Rich Reservoir Facies: Viola Springs Formation, Fitts Pool, Pontotoc County, Oklahoma**, by Michael P. Sykes, James Puckette, and Zuhair Al-Shaieb

**Sequence Stratigraphy and Evolution of the Hunton Ramp Carbonates**, by Zuhair Al-Shaieb and James Puckette

**The Role of Woodford–Hunton Depositional Relationships in Hunton Stratigraphic Traps**, by Kurt Rottmann

**Depositional and Diagenetic History of Mississippian Chat Reservoirs, Northern Oklahoma**, by Suzanne M. Rogers, James M. Forgotson, Jr., and Thomas A. Dewers

**Effects of Depth on the Quality of Gas-Well Completions in Carbonate Reservoirs of the Anadarko Basin and Shelf Areas, Oklahoma**, by Thomas J. Woods and Paul W. Smith

**A New Look at the Reservoir Geology of the Mississippian Schaben Field, Ness County, Kansas**, by Timothy R. Carr, Willard J. Guy, Evan K. Franseen, Saibal Bhattacharya, and Howard R. Feldman

**Mississippian Carbonate Stratigraphy Surrounding the Transcontinental Arch and Its Tectono–Stratigraphic Significance**, by H. Richard Lane, Mark Frye, and G. D. Couples

**Depositional and Post-Depositional History of Lower Mississippian Carbonates, Southern Ozark Region**, by Walter L. Manger

**Sequence Stratigraphy and Reciprocal Sedimentation in Middle and Late Pennsylvanian Carbonate-Bank Systems, Eastern Shelf of the Midland Basin**, by Arthur W. Cleaves

**Exploration- and Production-Scale Lateral Variability in Phylloid Algal Mounds and Associated Reservoir Facies, Paradox Basin, USA**, by Michael Grammer and Gregor Eberli

**Sequence Stratigraphy and Reservoir Development, Marble Falls Limestone (Pennsylvanian), Central Texas**, by Walter L. Manger and Patrick K. Sutherland

**Characteristics of Cyclical, Mixed Carbonate/Siliciclastic Reservoirs: Early Permian Chase Group, Northern Oklahoma**, by James R. Chaplin

**Improved Dolomite-Reservoir Characterization Through Integrated Log and Core Analysis: Example from Welch Field, Dawson County, Texas**, by Gregory D. Hinterlong

**Seismic Prediction of Reservoir Properties in a San Andres Carbonate Reservoir, Welch Field, Dawson County, Texas**, by George P. Watts and Gregory D. Hinterlong

## *Poster Presentations*

**Carbonate Development and Potential Productivity in the Southern Fort Worth Basin, Texas**, by Deborah K. Sacrey and A. H. Wadsworth

**Production and Reservoir Characteristics of Selected Hunton Fields in the Anadarko Basin**, by Paul W. Smith, Walter J. Hendrickson, and Craig M. Williams

**Petroleum Production from Platform Carbonates of Oklahoma**, by G. Carlyle Hinshaw, Kenneth S. Johnson, and Robert A. Northcutt

**Integrated Reservoir Management and Reservoir Characterization of the North Robertson Unit, Gaines County, Texas**, by P. K. Pande, James E. Kamis, Richard Vessel, and Mike Clark

**Microbial Reservoir Characterization of the Hobart Field, Kiowa County, Oklahoma**, by Daniel Hitzman, James D. Tucker, and Brooks A. Rountree

**Sonic Velocity in Carbonates—A Product of Original Composition and Post-Depositional Porosity Evolution**, by Flavio S. Anselmetti and Gregor P. Eberli

**Reservoir Characterization of an Upper Permian Platform Carbonate in Preparation for a Horizontal-Well $CO_2$ Flood, South Cowden Unit, West Texas**, by Craig D. Caldwell, Matt Gerard, and Susan Snow

**The Initiation of Carbonate Sedimentation in the Southern Oklahoma Aulacogen: Part 2**, by R. Nowell Donovan

**Depositional Environments/Carbonate Diagenesis of the Council Grove Group, Hugoton Embayment, Southwest Kansas**, by Nicholas J. Pieracacos

**Facies, Stratigraphic Relationships, and Fracturing in the Wapanucka and Spiro**, by Darrell Mauldin

**Lithofacies Distribution and Reservoir Heterogeneity within Pennsylvanian Bioherms, Western Orogrande Basin, New Mexico**, by Gerilyn Soreghan and Katherine Giles

**Union Valley Limestone Bank (Morrowan, Pennsylvanian), Eastern Oklahoma**, by James R. Derby and James O'Brien

**Depositional and Diagenetic History of Mississippian Chat Reservoirs, Northern Oklahoma**, by Suzanne M. Rogers, James M. Forgotson, Jr., and Thomas A. Dewers

**Lithostratigraphy and Biostratigraphy of a Core from the Viola and Simpson Groups in Keener #1-B Well, Creek County, Oklahoma**, by James R. Derby, James O'Brien, and John E. Repetski

**Stratigraphy of the Roubidoux Formation of Missouri and Correlative Units in the Southern Midcontinent**, by John E. Repetski, James D. Loch, Raymond L. Ethington, and Russell I. Dresbach

**Regional Correlations of the Springer and Chester Groups Within the Oklahoma Portion of the Anadarko Basin and Shelf Demonstrating the Facies Changes Within the Springer Which Have Resulted in Springer Being Misidentified as Chester**, by Paul W. Smith, Lindell C. Bridges, Walter J. Hendrickson, Craig M. Williams, and Ronald J. Woods

**Integrated Analyses of Reservoir Petrofacies in Platform Carbonates of Kansas: Techniques and Case Studies**, by John H. Doveton, W. Lynn Watney, and Willard J. Guy

## *Registration Information*

Advance registration (prior to March 1) is $50, which includes two lunches and a copy of the proceedings. Late and on-site registration will be $70 per person. Lodging will be available at the Conference Center.

For more information, contact Kenneth S. Johnson, General Chair, Oklahoma Geological Survey, University of Oklahoma, 100 E. Boyd, Room N-31, Norman, OK 73019; phone (405) 325-3031 *or* (800) 330-3996 *(in Oklahoma and adjacent states)*; fax 405-325-7069. To request registration forms, contact Tammie Creel at the same location and numbers.

# INDEX[1]

## Volume 55, 1995



[1]Reference is to first page of article containing indexed item.

*C*

***D***

*S*



*T–U*