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TWO MEASURED SECTIONS OF JACKFORK GROUP IN SOUTHEASTERN OKLAHOMA

By

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DESCRIPTION AND CORRELATION OF TWO COMPLETE STRATIGRAPHIC SECTIONS OF THE JACKFORK SANDSTONE IN KIAMICHI MOUNTAINS, CENTRAL OUACHITA MOUNTAINS, OKLAHOMA

by

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Stanley-Jackfork-Atoka Relations in The Central Ouachitas

Objectives of this paper.—This paper describes and correlates two complete stratigraphic sections of the late Paleozoic Jackfork sandstone that are well exposed in the Kiamichi Mountain Range in the central Ouachita Mountains in southeastern Oklahoma. A complete and unfaulted Jackfork sequence has not heretofore been described for the Ouachita Mountains, although reference has been made (Cline, 1956a, p. 427) to the recognition in the Kiamichi Range of several of the map units which Harlton (1938) had earlier differentiated in the frontal Ouachitas to the west; some of these units were observed by geologists in attendance at the recent field conference (May 4 and 5, 1956) on the geology of the central Ouachita Mountains sponsored by the Ardmore Geological Society and the units were briefly discussed (Cline, 1956b, pp. 47-63) in the accompanying guidebook. Current interest in the geology of the Ouachita Mountains, and indeed in the entire Ouachita foldbelt, behooves us to call attention to these two fine exposures. The two sections are about 22 miles apart, have the same structural strike, and probably had about the same sedimentary strike at the time of deposition.

General relations of the Jackfork sandstone.—In the heart of the Ouachita Mountains in southeastern Oklahoma, late Mississippian and early Pennsylvanian sedimentary rocks embraced in the Stanley-Jackfork-Atoka sequence have an aggregate thickness somewhat in excess of 18,950 feet. The rocks are overwhelmingly clastic with shale predominating in the Stanley, sandstone being most important in the Jackfork, and with the two rock types being in subequal proportions in the Atoka. Carbonate rocks are noticeably absent in the Ouachita facies of the Mississippian and Pennsylvanian and until recently only one persistent zone of marine fossils had been located south and east of the Kiamichi River, that being Honess' (Honess, 1924, pp. 14-16) "Morrow" fauna which occurs in the mid-portion of the Jackfork sandstone (as it was mapped at that time) in the Boktukola syncline. The

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Boktukola syncline lies well within the central Ouachitas, somewhat north of the "core" area which exposes the relatively thin section of pre-Stanley Paleozoic rocks (black shales and cherts are characteristic). It should be noted that Honess included as his upper Jackfork the strata that we are referring to the Atoka formation, although he recognized the Morrow age of the basal part of his Upper Jackfork.

Correlation of the thick clastic late Paleozoic section of the central Ouachitas with rocks of the same age in the vicinity of the Arbuckle Mountains and equivalent strata in the northeastern Oklahoma platform has long posed some problems. There are important facies changes as one proceeds from the Ouachita province into the Arkansas Valley province and thence on to the Oklahoma platform. Important facies changes affect all of the Paleozoic strata but the most noticeable changes which affect rocks of Stanley-Jackfork age take place along the border of the Arkansas Valley and Ouachita Mountain structural provinces. Limestones grade into shales and sandstones to the south and there are rapid increases in thickness in most of the units as they are traced southward. Facies changes are so abrupt in this zone that precise correlations between the two sedimentary provinces would have been difficult enough without any structural complications. And there are structural complications! The outer or frontal Ouachitas are divided into a number of fault blocks or slices by several important thrust faults. The amount of horizontal displacement along the thrusts is a matter of vigorous debate but it is sufficient to say that it is difficult to make precise correlations involving rocks of late Jackfork and early Morrow between some of the adjacent fault blocks.

Earlier stratigraphic work.—A most important contribution to the correlation of the Mississippian and Pennsylvanian strata of the two stratigraphic provinces was the work of Bruce Harlton (1934, 1938). Harlton differentiated, named, and mapped several persistent rock units in the Stanley-Jackfork sequence in the Round Prairie syncline, which lies northeast of Atoka in Atoka County, and in the south part of the Tuskahoma syncline north of Moyers, which is in western Pushmataha County. Both areas lie somewhat east and south of the intensely faulted belt of the frontal Ouachitas which belt was later mapped by Hendricks and his coworkers (Hendricks, Gardner, and Knechtel, 1947) of the United States Geological Survey. These men were successful in differentiating map units in the Jackfork in this structural subprovince in a belt extending from Atoka on the southwest to Oklahoma Highway 2 midway between Wilburton and Clayton on the northeast.

The present study.—The present study of the Stanley-Jackfork-Johns Valley-Atoka sequence was begun in 1953 under the sponsorship of Dr. C. W. Tomlinson of Ardmore, Oklahoma, and work has continued intermittently as time would permit. As a

result of many years of work in the Paleozoic rocks of southern Oklahoma, Tomlinson had reached the conclusion that the Lynn Mountain syncline, of which the Kiamichi Range is the higher topographic element, probably contains Atoka equivalents. Tomlinson pointed out to Cline the similarity in the patterns on the aerial photographs of the eastern limb of the Tuskahoma syncline east of Johns Valley and those of the northern face of the Kiamichi Range south and east of the Kiamichi River valley. Tomlinson suggested that the map units recognized by Harlton in the Tuskahoma syncline are probably present in the hills southeast of the valley of the Kiamichi River. Following up Tomlinson's suggestion, Cline has been able to recognize most of Harlton's map units in the Lynn Mountain syncline and trace most of them eastward in the syncline almost to the Arkansas line. The persistent beds have been traced by surface mapping aided by aerial photographs. The photographs have served as a base and have also been a great aid in tracing and recognition of formations.

The two stratigraphic sections which are described and discussed in this paper were first described and measured by L. M. Cline and Frank J. Moretti in April, 1955. Moretti collected numerous samples of the Jackfork sandstone and a zone-by-zone study of the mineralogy and lithology of these samples is now being made by him.

Conclusions

(1) The Jackfork sandstone occurs in an unbroken, unfaulted sequence in the Kiamichi Range. Two complete and well-exposed stratigraphic sections, one southeast of Albion, Pushmataha County, the other southeast of Big Cedar, southern Le Flore County, are described in this paper. The two sections are about 22 miles apart, are structurally aligned, and probably are about on sedimentary strike. The best exposures in both sections are in roadcuts, one series of cuts now being several years old, the other having been completed only about a year ago, thus affording an opportunity to compare fresh strata with their somewhat weathered equivalents.

(2) Most of the rock units which Harlton differentiated, named, and mapped in the Round Prairie and Tuskahoma synclines are present in the Kiamichi Range. This is the first time that these units have been recognized southeast of Kiamichi River.

(3) Most of the recognized units persist as far east in the Kiamichi Range as the Arkansas line. Reconnaissance work reveals that some of these units are also present in the Boktukola syncline south of the Lynn Mountain syncline.

(4) The relationship of the Wildhorse Mountain formation to the Prairie Mountain formation is better understood inasmuch as both are well exposed in the same stratigraphic section. The Prairie Hollow maroon shale is included in the Wildhorse Mountain formation (rather than the Prairie Mountain formation to

which it was originally assigned) because it is present in the type section of the Wildhorse Mountain formation, which formation is better exposed and better described than the Prairie Mountain and the description has page preference over that of the Prairie Mountain.

(5) The total thickness of the Jackfork sandstone is 5,600 feet and 6,000 feet respectively in the two measured sections. The greater of these two thicknesses is substantially less than some previous estimates of the thickness of the Jackfork.

Stratigraphic Section I

Location.—Cutbanks and roadside ditches along the Indian Service Road in the Kiamichi Range, southeast of Albion, Pushmataha County, Oklahoma. The oldest rocks are exposed at the foot of the north-facing escarpment on the north flank of the range in the NW¼ NW¼ sec. 30, T. 2 N., R. 22 E. The strata have a strong southward dip, averaging perhaps 38 degrees, and exposures are almost continuous as the road winds successively through the east side of sec. 25, T. 2 N., R. 21 E., the NW¼ of sec. 31, T. 2 N., R. 22 E., the east part of sec. 36, T. 2 N., R. 21 E., with the top of the described section being a bit northeast of the center of sec. 1, T. 1 N., R. 21 E.

Top	Thickness in Feet
Pennsylvanian system	
Atoka sandstone	
111. Shale; 95% of interval composed of laminated, medium blue-gray silty shale; remainder of interval composed of thin, hard, white siltstone and fine-grained sandstone beds which are commonly less than a foot thick. About five feet of sandstone at base of interval. The top of the described section was arbitrarily terminated at a two-inch black, cherty, siliceous shale above which additional silty blue-gray shale is exposed	210
110. Covered; forms a strike valley which is probably underlain by shale	190
109. Poorly exposed interval; basal 50 feet has poorly exposed yellowish-weathering sandstone; top 70 feet weathers to brownish-red sandy soil	120
108. Sandstone; soft, friable, ash-gray sandstone which includes some zones of quartz granule conglomerate; deeply iron-stained upon weathering. Closely pitted by the solution of pieces of clastic calcite including fragments of Bryozoa, crinoid columnals, and brachiopods. Contains Honess' "Morrow fauna"	165
107. Sandstone; medium to coarse-grained, fossiliferous gray sandstone. Molds which represent calcitic fragments (including crinoid columnals) up to granule size that have been dissolved	40

Top	Thickness in Feet
Johns Valley shale?	
106. Poorly exposed shale and sandstone; largely poorly exposed light blue-gray sandy shale with thin layers of fine-grained white sandstone and coarse siltstone which appears in the float on weathered surfaces. A thin one-inch band of purplish-gray weathering siliceous shale or chert is abundant in the float at the very base of the zone	145
"Union Valley" sandstone	
105. Sandstone and some poorly exposed shale; hard sandstone in beds averaging 10 inches and having ripple marks and worm trails on the upper surfaces; encloses crinoid columnals and plant fragments. The worm trails on the top two layers resemble some found in the upper Johns Valley shale at other localities	70
104. Sandstone; interval 95% sandstone; soft and yellow-weathering at the base, becoming evenly bedded and quartzitic near the middle, and including some silty beds near the top	90
Jackfork sandstone	
Wesley shale	
103. Poorly exposed gray sandy shale with thin one-inch beds of hard white siltstone which weathers light-gray.	
102. Poorly exposed soft blue-gray sandy shale	30
101. Gray, plastic, bedded shale with lenses of sandstone. A six-inch bed of dark gray to black, green-gray weathering chert which weathers to 6" x 6" x 6" rhombohedrons occurs at top of interval. The chert is a good key bed	70
Markham Mill shale?	
100. Sandstone; soft, ash-gray with limonitic stains along the bedding laminations and joints. Develops a red mottling upward within the zone of active weathering	58
99. Lower part of interval covered, but soft, friable iron-stained sandstone is exposed in the upper half of the interval	160
98. Sandstone; resistant, terrace-forming	15
97. Poorly exposed sandstone; hard, ripple marked, in 2 to 3 foot beds. A hard, black, almost cherty, siliceous shale occurs about 20 feet above the base	95
Prairie Mountain formation	
96. Sandstone: hard, white, stained brown and red by iron, closely jointed into rhombohedral blocks 3" x 3" x 1½"	4½
95. Sandstone; soft, friable, ash-gray sandstone and sandy clay-shale, cut with limonite filled joints. Thickness difficult to determine because road is nearly parallel to strike	50

Top	Thickness in Feet
94. Covered; along ridge crest; float indicates hard, pink, quartzitic sandstone may underlie most of it	220
93. Sandstone; white, pink, and brown, hard, quartzitic fine to medium-grained in beds averaging about one foot in thickness. Exposed along ridge crest near intersection with Summit Trail	13
92. Covered	40
91. Sandstone; poorly sorted, fine to medium-grained, ash-gray weathering yellowish; in massive beds up to 18 feet in thickness	150
90. Sandstone; light gray, in firm, hard 8-inch slabby beds, weathers yellow-brown	5
89. Covered; white sandstone float	90
88. Shale and sandy shale; weathers very light blue-gray with red mottling and eventually to deep red-brown soil containing fragments of very hard, ash-gray weathering coarse siltstone and fine sandstone	60
87. Shale and sandy shale; like zone 88, poorly exposed	20
86. Sandstone and shale; 60% of the interval composed of sandstone in massive 2 to 4 foot beds; medium gray, poorly sorted, hard; 40% composed of laminated blue-gray shale with some sandy beds in units about 2 to 3 feet thick	36
85. Shale; dark blue-gray, laminated with intercalated ½-inch lenses of gray siltstone and a few beds of thin, hard, brownish-gray sandstone	22
84. Sandstone; firm to friable, light gray to ash-gray, weathers yellow to brown, iron staining common on exterior; medium-grained, poorly sorted	60
83. Covered; probably like zone 82	198
82. Sandstone and sandy shale in about equal proportions; soft, friable, gray to white, medium-grained sandstone in beds as thick as 3 feet; iron stained	35
Wildhorse Mountain formation	
81. Covered	15
80. Sandstone and shale; alternating one-foot beds of hard medium gray sandstone and blue-gray shale	10
79. Covered	15
78. Sandstone and shale; 85-90% medium gray sandstone in even 1 to 2-foot beds in units up to 50 feet thick separated by gray and brown lignitic shale masses up to 10 feet thick; the top 20 feet is dark laminated shale	235
77. Covered	105
76. Sandstone; hard, dense, evenly bedded; separating dark sandy shales comprise 30% of volume	55
75. Sandstone; white, friable; iron-staining along joints; some very sandy lignitic shale	50

Top	Thickness in Feet
74. Sandstone and sandy shale; hard, evenly bedded, fine-grained, medium to light gray sandstone, separated by sandy to laminated blue-gray shales with intercalated hard light colored siltstone layers	74
73. Sandstone; massive, terrace-forming unit; in thick beds, about one-half being 8 feet, about one-half averaging about 2 feet; hard, medium gray, appearance not unlike that of a limestone; separated by 4- to 6-inch shale beds	200
72. Covered; some poorly exposed sandstone	30
71. Sandstone; moderately soft, white, weathers tan; in fairly massive beds	60
70. Sandstone and shale; hard, two-foot beds of sandstone comprising 65% of lower portion of interval and 85% of upper portion; interbedded blue-gray shales	135
69. Sandstone; very massive, white, medium-grained, poorly sorted, buff-weathering; a zone of quartz granule conglomerate lies a short distance below the middle	33
68. Shale; blue-gray; contains sandy lenses; a 2-foot bed of sandstone near top	22
67. Sandstone; somewhat massive, white, weathers yellowish	20
66. Sandstone and shale; massive sandstone at base followed successively by a 6-8 foot covered interval, sandstone, and 6 feet of gray shale at top	40
65. Covered; some poorly exposed sandstone	95
64. Sandstone; a massive 12-foot ledge of clean white sandstone which weathers yellowish	12
63. Shale and sandstone; lower one-half of interval covered, upper one-half mostly dark laminated shale with a few hard massive sandstone beds ranging in thickness from 3 inches to 2 feet	32
62. Sandstone; in massive beds as thick as 15 feet; fine-grained, hard, quartzitic; white, weathers yellowish or brown due to iron transfer	85
61. Sandstone; prevailingly soft, yellow-weathering sandstone with about 20% of the interval being dark blue-gray laminated shale that weathers blue-gray	225
60. Lower one-half of interval covered; upper portion contains some ledges of massive, structureless, yellow sandstone	90
59. Dark laminated shale comprises 90% of interval; some 1-foot ledges of hard, quartzitic sandstones near top of interval	20
58. Covered	25

Top	Thickness in Feet
57. Shale and sandstone; about 75% composed of dark gray to black laminated shale with intercalated sandstone lenses; thinly bedded, hard, white, quartzitic sandstones comprise about 25% of the interval	51
Prairie Hollow maroon shale member	
56. Soft, poorly sorted, massive, green sandstones weathering buff; brownish-red clay shale containing carbonized plant fragments, weathers reddish; some blocky green-gray clay shale; forms strike valley	208
55. Soft lignitic sandy shale and thin 2 to 3 inch beds of hard, fine-grained, white sandstone with numerous flow casts on lower bedding surfaces. Base of Prairie Hollow member	27
54. Sandstone; hard, clean, white, poorly sorted sandstone, locally case hardened, and averaging 1½ feet thick comprise 60% of section; remainder composed of softer sandstone and this gray shales	70
53. Sandstone; poorly sorted, silty, massive to well bedded, buff-weathering sandstone and brown, lignitic sandy shale containing plant fragments	73
52. Shale; laminated, dark blue-gray weathering light blue-gray with thin laminae of white to gray siltstone and fine-grained, hard, quartzitic sandstone	37
51. Sandstone; mostly hard, quartzitic, light colored	75
50. Sandstone cropping out in two-thirds of interval; light gray, friable, silty, weathers buff	100
49. Covered; probably mostly sandstone	115
48. Sandstone similar to that of zone 56 but two four-foot zones of blue-gray clay shale, near the base	85
47. Sandstone; fine-grained, light gray to pink, very hard quartzitic, in even beds averaging 1½ feet thick	72
46. Covered; probably sandstone	55
45. Shale; soft sandy shale and light blue-gray shale weathering to a reddish-brown soil	38
44. Sandstone; two hard, even, subequal beds of clean, white, quartzitic sandstone	4
43. Sandstone; soft, friable, fairly clean, gray sandstone; rather massive beds	59
42. Covered	45
41. Poorly exposed yellowish weathering, lignitic, gray sandstone with abundant carbonized plant fragments	35
40. One to two-inch beds of laminated, white quartzitic sandstone embedded in blue-gray laminated shale; poorly exposed	30
39. Soft, friable, massive sandstone that weathers buff and with checked, cracked surfaces comprises 80% of interval	117

Top	Thickness in Feet
38. Gray, friable, buff-weathering sandstone that case hardens with a limonitic shell comprises two-thirds of interval; laminated dark gray shales comprise the remainder of interval	82
37. Shale; medium blue-gray, weathers light blue-gray with iron staining	12
36. Fine to medium-grained, buff-weathering, iron-stained sandstone	14½
35. Shale; light blue-gray with sandy lenses, weathers with red mottling	25
34. Covered	80
33. Poorly exposed, but about 60% of interval exposes massive, poorly bedded, buff- to brown-weathering sandstone; medium-grained, poorly sorted, friable	90
32. Sandstone and shale; subgraywacke sandstone comprises 50% of lower one-third of interval, increases to 70% in the mid-portion and to 90% at top; interbedded shales are medium blue-gray; the sandstones in upper portion of interval are light colored, fairly clean and quartzose	128
31. Sandstone; medium-grained, poorly sorted, lignitic, micaceous, buff-weathering, massive sandstones in beds as thick as 6 feet	37
30. Poorly exposed shale with some buff-weathering subgraywacke sandstone exposed	35
29. Poorly exposed blue-gray shale with occasional one-foot beds of case-hardened, light gray, quartzitic sandstone	56
28. Sandstone; poorly sorted, medium-grained, fairly clean, quartzose sandstone in massive beds as thick as 6 feet; a ferruginous cement aids case hardening of weathered surfaces; weathers buff to brown; flow casts are well developed although separating shale seams are exceedingly thin	38½
27. Interval containing some thinly bedded, almost laminated, quartzitic, fine-grained sandstones, but dirty subgraywacke sandstones predominate	27
26. Sandstone; fine to medium-grained, poorly sorted, dirty, buff-weathering; in beds up to 5 feet thick	54
25. Sandstone and shale; about 50% of interval comprised of buff-weathering subgraywacke sandstone; about 50% composed of soft, blue-gray, laminated shale alternating with brownish, lignitic, sandy shale which weathers reddish	75
24. Interval composed predominantly of soft blue-gray laminated shale, locally somewhat sandy; a few evenly bedded eight-inch beds of light gray quartzitic sandstone are intercalated	85

Top **Thickness in Feet**

Stanley shale

Chickasaw Creek siliceous shale formation

23. Siliceous shale and chert; hard black, blocky, siliceous shale in beds averaging 3 to 4 inches; several thin beds of black chert speckled with spherical to almond-shaped areas of white silica 10
22. Lower half of interval composed of badly weathered light blue-gray clay shale with thin beds of light gray, hard, quartzitic sandstone; upper portion dark blue-gray, slightly blocky shale that weathers to a brownish-red soil 102
21. Sandstone; hard, well bedded, clean, quartzitic sandstone at base grading upward into softer, dirty more massive subgraywacke 9
20. Soft, poorly sorted argillaceous sandstones and thin-bedded sandy lignitic shales 15½
19. Sandstone; hard, evenly bedded, light gray, quartzitic sandstone in beds less than a foot thick separated by thinner beds of dark blue-black shale; the sandstones exhibit some small scale cross-bedding and have very flat bedding surfaces 4
18. Siliceous shale; blue-black, laminated; breaks into "pencil" shale prisms 4" x 1" x 1" 6
17. Sandstone; fine to medium, gray when fresh, weathers buff; hard, quartzitic, locally thin and wavy bedded 4
16. Laminated sandstone with blue-gray shale partings 2½
15. Predominantly buff-weathering subgraywacke sandstone but with some sandy shale and a small amount of laminated blue-gray shale 66
14. Sandstone; gray, fine-grained, hard, quartzitic, exhibits some laminated small scale cross-bedding 3
13. Black, blocky, siliceous shale 2½
12. Blue-black, laminated siliceous shale 5
11. Chert; one massive bed, brittle, closely jointed, black speckled with white almond-shaped areas which Harlton has identified as Radiolaria and enlarged Radiolaria; fresh surfaces reveal fine bedding laminae; iron-stained when weathered .... inches, 3½
10. Shale; sandy below, blue-gray and siliceous above 3
9. Soft, massive sandstone like zone 8 comprises the lower one-half of interval; becomes shaly above 21
8. Sandstone; buff or tan weathering, dirty, poorly sorted; poorly bedded, fairly massive; some granule size fragments that seem to be weathered feldspar; molds of crinoid stems and cylindrical bryozoans 7½
7. Shale; soft, blue-gray, laminated; a few discontinuous laminae of light gray coarse siltstone or fine sandstone 13½

Top **Thickness in Feet**

6. Sandstone; moderately hard, fairly massive but with some evidence of bedding; dirty, poorly sorted; contains fragments of crinoid columnals and dark carbonaceous plant fragments 5½
5. Shale; blue-gray, laminated, in early weathering stages is green-gray and platy 6½
4. Sandstone; massive, very fine-grained, hard, limonitic, matrix 1
3. Shale; laminated, blue-gray, plastic when wet; weathers greenish-gray in early stages 3
2. Sandstone; fairly massive, weathers buff to sand-colored; checks upon weathering; dirty, poorly sorted, subangular, fine-to medium-grained ....
1. Shale; thin-bedded, platy to fissile, locally laminated, dark green-gray to blue-gray, weathers buff 18

Base of described section begins just south of iron drain tile.

Discussion of Section 1

ATOKA SANDSTONE

Only the lowermost portion of the Atoka formation is included in this description but several thousand feet of sandy shales and sandstones of Atoka age occupy the trough of the Lynn Mountain syncline and are exposed south of the described section. The sandstones shown as zones 107-109 contain a marine invertebrate fauna that probably represents the same horizon as Honess' "Morrow" fauna of the Boktukola syncline, the next syncline to the south. Fossils collected here have been studied by Dr. M. K. Elias of the University of Nebraska who reported to Dr. C. W. Tomlinson (letter dated March 19, 1954) that the fauna is similar to that of Honess' Glover Creek locality and we have noted (Cline, 1956b, p. 53) that the similarity of the stratigraphic succession below the fossiliferous sandstone in both synclines supports this correlation. Casts and molds of crinoid columnals, brachiopods, bryozoans, and other marine invertebrates occur in several layers of the sandstone. One zone that is especially noteworthy is a friable, ferruginous sandstone that contains some layers of granule conglomerate. The weathered sandstone has a peculiar pitted appearance where pieces of clastic calcitic material have been removed by solution; many of the fragments were bits of shell debris and skeletal elements of invertebrates.

Johns Valley shale?

Zone 106 consists of 145 feet of blue-gray shale containing some thin beds of sandstone and this interval may represent the Johns Valley shale. The correlation (Cline, 1956b, p. 53) is purely tentative and is made solely on the basis of its stratigraphic position below the sandstone with the "Morrow" fauna and its place above the fossiliferous "Union Valley sandstone" of Harlton.

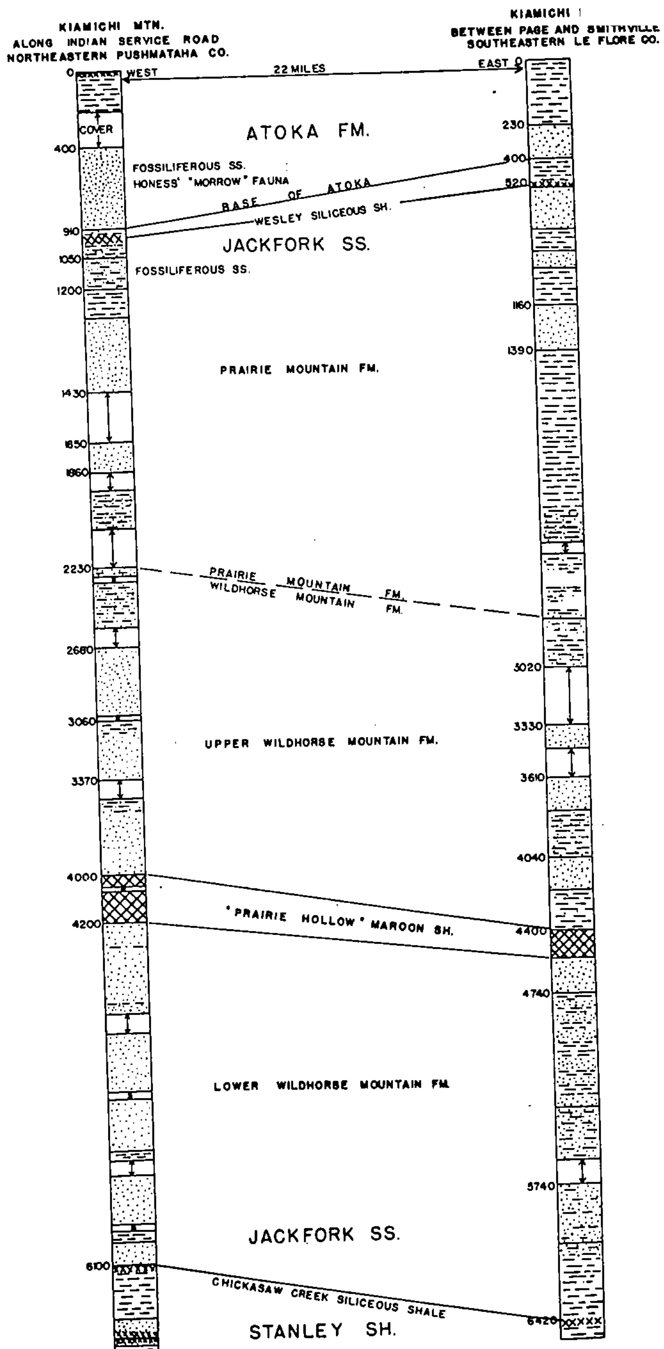

FIG. 4

CORRELATION OF TWO COMPLETE STRATIGRAPHIC SECTIONS OF THE JACKFORK SANDSTONE

Cropping Out In Kiamichi Mountain in the East-Central Ouachita Province, Oklahoma

By L. M. CLINE and FRANK MORETTI; Described April, 1955

"Union Valley sandstone"

The fossiliferous sandstone described as zones 104 and 105 is a persistent unit and is correlated with Harlton's "Union Valley sandstone" with a considerable degree of assurance. The crinoid columnals and plant fragments are diagnostic of this formation and the worm trails and ripple marks are perhaps equally characteristic.

Jackfork Group

Wesley shale

The Wesley shale is exposed just south of a sharp curve in the road, in deep gullies which mark the intersection of an old road. About 150 feet of shales and soft sandy shales which contain at least one thin bed of siliceous shale or chert somewhere near the mid-portion form a belt that is easily traced on aerial photographs. The siliceous shale is hard, black, closely jointed so that it weathers into rhombohedral blocks about 6" x 6" x 6" and which weather to a characteristic green-gray colored chert. The chert rhombs are easy to identify in float and have aided in the tracing of this shale eastward to the Arkansas line and westward to Highway 2 south of Clayton. It is also correlated with a shale in a similar stratigraphic position in the Boktukola syncline (Cline, 1956b, p. 50). On the basis of stratigraphic position, tracing on aerial photographs supplemented by mapping on the ground, and on the basis of lithology, this shale has recently been correlated by us with the Wesley shale of the Tuskahoma and Round Prairie synclines much farther west. Mr. Bruce Harlton, who named and described the type Wesley, has examined the outcrop with us and he concurs in this correlation.

Markham Mill formation

On the basis of stratigraphic position the rocks immediately beneath the Wesley shale should be equivalent to the Markham Mill formation of the frontal Ouachitas. A hard black siliceous shale occurs about 20 feet above the base of the section that we have assigned to the Markham Mill but we do not know whether this bed is persistent.

Prairie Mountain formation

Both boundaries of this formation are arbitrarily assigned. The boundary with the underlying Wildhorse Mountain formation is especially arbitrary and is placed at the top of some massive sandstones which lie near the crest of the Kiamichi Range at this locality and which appear to be laterally persistent.

Wildhorse Mountain formation

Massive sandstones near the top of the formation form prominent ridges and rock terraces that are easily traced on aerial photographs. Whether individual beds persist laterally for any considerable distance is not known but collectively the sandstones exert a strong influence on topography where they occur, from the frontal Ouachitas on the west to the Arkansas line on the east. The upper Wildhorse Mountain sandstones are more massive, whiter, cleaner, more quartzose, and better sorted than those in the lower part of the formation. A quartz granule conglomerate occurs near the base of the upper one-third of the formation and crops out upslope (generally southwest) from the hairpin curve in the road.

Prairie Hollow maroon shale member.—Zones 56 and 57 are referred to the Prairie Hollow maroon shale. The reddish-brown shale, the blocky green-gray clay shale, and the poorly bedded, poorly sorted green-gray sandstones are characteristic features of this member. The red-brown color of the shales at this locality is a primary feature and should be expected in the subsurface. The ratio of red to green-gray rock varies somewhat from locality to locality and evidently depended on the oxidation-reduction potential of the environment of deposition.

Lower portion of Wildhorse Mountain formation.—A noteworthy feature of the sandstones in the lower portion of the formation is that many beds are silty, poorly sorted, and would be termed subgraywackes by some petrographers. This is in contrast to the cleaner, whiter, more quartzose sandstones in the upper portion of the formation some of which would be termed orthoquartzites by petrographers.

Stanley Group
Chickasaw Creek siliceous shale

About 300 feet of beds, mostly dark blue-gray to black siliceous shales with some intercalated thin beds of quartzitic siltstone and sandstone are referred to the Chickasaw Creek formation. About 90 feet below the top of the formation is the top of a 10-foot siliceous shale. The shale is hard, evenly bedded in 3 to 4 inch beds, and includes several beds of black chert which is mottled with white, round to almond-shaped siliceous areas from one to several millimeters in diameter.

Stratigraphic Section II

Location.—Roadcuts and adjacent outcrops in Kiamichi Mountain southeast and south of Big Cedar, southeastern Le Flore County, Oklahoma. The Wildhorse Mountain formation is beautifully exposed in a series of road cuts in the new road which winds up the steep north face of the Kiamichi Range in secs. 23, 24, 25, 26, and 27, T. 2 N., R. 25 E. The heavy sandstones which form the approximate boundary between the Wildhorse Mountain and Prairie Mountain formations underlie the high portion of the Kiamichi Range and are exposed at the intersection of Blue Bouncer Trail. The Prairie Mountain and higher formations are exposed in secs. 32 and 33 of the same township and in sec. 5, T. 1 N., R. 25 E.

Top	Thickness in Feet
Atoka formation	
63. Poorly exposed sandy shale with rectangular blocks of hard quartzitic sandstone. Sandstone float containing a sandstone cast fauna was found in this interval. The fauna may be Honess' "Morrow fauna".	
62. Poorly exposed blue-gray shale	90
61. Shale and thin-bedded sandstone. Shale predominates near the base but at the top the well-bedded, thin, white sandstone may comprise 40% of the rock	245
60. Sandstone and sandy shale; hard, white, quartzitic sandstone comprises 60% of the interval	165
Jackfork sandstone	
Wesley shale	
59. Shale; weathers light blue-gray; contains at least one 5-inch bed of black green-gray weathering chert	150
Markham Mill and Prairie Mountain formations	
58. Sandstone; soft, green-gray, a small amount of interbedded lignitic sandy shale near top	38
57. Shale; sandy; exposed at sharp curve in road	27
56. Sandstone; some very hard white massive rock but toward the top becomes green and friable	148
55. Light blue-gray sandy shale with rounded boulder-like masses of brown-gray quarzitic sandstone	105
54. Poorly exposed, massive, yellow-weathering sandstone	90
53. Shale and sandstone	195
52. Massive to medium bedded, fine-grained, firm white sandstone; weathers yellow; thickness of interval hard to calculate	230
51. Poorly exposed light blue-gray sandy shale with some intercalated hard, thinly bedded, quartzitic sandstone	650
50. Light gray yellow-weathering sandstone and sandy shale in about equal proportions	278
49. Shale; soft, slightly sandy at base; weathers light gray	52
48. Massive yellow sandstone	20
47. Covered; some poorly exposed yellow-weathering sandstone	50
46. Poorly exposed sandy blue-gray shale and soft sandstone; exposed in the saddle where the new highway intersects the old road to Big Cedar	327
Wildhorse Mountain formation	
45. Sandstone; soft, medium-grained, light gray, weathers yellow	40

Top — Thickness in Feet

44. Shale with subordinate sandstone; dark blue-gray laminated shale with interlaminated gray siltstone and sandstone with evenly bedded white quartzitic sandstone; sandstone comprising 35% of upper portion of interval, relatively unimportant in lower portion 120
43. Sandstone and shale; 80% of interval comprised of fine-grained, hard, well bedded, quartzitic sandstone in beds up to 1½ feet thick; dark gray sandy shale intercalated, becoming important toward the base 55
42. Shale and sandstone; soft white sandstone at base grading upward into blue-gray laminated silty shale 35
41. Covered; poor exposures indicate sandy shale 310
40. Sandstone; soft, yellow-weathering; thickness hard to calculate because road parallels strike 50
39. Sandstone; hard, white to light gray, well bedded in even beds two feet thick 75
38. Lower one-half of interval covered; upper one-half appears to be badly weathered gray sandy shale with interbedded fine-grained quartzitic sandstone 155
37. Sandstone; hard, white to pink, fine-grained, quartzitic sandstone; forms crest of ridge where highway cuts through 170
36. Shale and sandstone; dark blue-gray sandy shale and hard to firm gray sandstone; sandstone-shale ratio 60:40 135
35. Sandstone and shale; sandstone comprises 65-70% of interval; remainder composed of dark blue-black shale with alternating laminae of gray siltstone and some sandstone beds up to a foot in thickness 117
34. Shale; black with interlaminated gray siltstone (35%); one bed of hard, quartzitic sandstone 9½
33. Sandstone; predominantly hard, medium blue-gray, subquartzitic sandstone in beds averaging from 2 to 6 feet; rarely a well bedded silty shale intervenes; a fault with small displacement down to west 265
32. Shale and sandstone; dark blue-gray shale with interlaminated 1 to 2 inch beds of hard quartzitic gray sandstone occurring in 30% of interval; total sandstone content estimated at 45% of interval 52
31. Predominantly dark gray laminated shale interbedded with thin 1 to 2 inch beds of gray sandstone; occasional 2 to 5 foot beds of soft, dirty, poorly sorted, yellow-weathering sandstone; grades into zone 32 above where the sandstone merely becomes more quartzitic and better jointed; about 60% shale and 40% sandstone 105

Top — Thickness in Feet

Prairie Hollow maroon shale member

30. Shale and sandstone; mostly gray shale and green-gray, silty, massive sandstone that weathers yellow; some brownish-red shale and silty shale at intervals 130
29. Sandstone; massive below becoming bedded above and containing a small amount of shale at top; hard and quartzitic below becoming poorly sorted and brown-gray above 30
28. Shale; dark blue-gray laminated shale with some silty and sandy beds included 39
27. Sandstone; fine-grained, blue-gray, hard, quartzitic, weathers brown; well defined beds about 2 feet thick 50
26. Shale; dark blue-gray to black, blocky clay-shale; some rounded hard quartzitic masses near the top that may be concretionary 52
25. Sandstone; gray, weathers brown-gray 73
24. Dark laminated shale and interlaminated hard, white, quartzitic sandstone in about equal amounts 135
23. Sandstone; soft, white, weathers yellowish; beds up to 2 and 3 feet thick 45
22. Shale and sandstone; dark blue-gray laminated shale interbedded with white, well bedded, quartzitic sandstone occurring as thin laminae in the shale; sand-shale ratio 4:6 173
21. Sandstone; soft, dirty, massive, weathers yellowish 40
20. Shale; blue-gray with beds of dirty gray sandstone 22
19. Covered 20
18. Interval 65% sandstone, 35% sandy shale; silty, poorly sorted, yellow-weathering sandstone; blue gray shale with interlaminated light gray siltstone or fine-grained sandstone; center of cut faulted; displacement unknown but not great 115
17. Predominantly laminated blue-gray shale with laminae of ash-gray siltstone; one 8-foot bed of yellow-weathering friable sandstone one-third the distance above the base 60
16. Covered; estimated 50
15. Sandstone; soft, friable, gray, weathers yellowish, in beds averaging about a foot in thickness; 95% sandstone in lower part of interval decreasing to 80% above 40
14. Shale; dark gray well-bedded shale with some light gray, hard, quartzitic sandstone in beds up to 6 inches; soft, friable, yellow sandstone begins to be prominent toward top 100
13. Sandstone and sandy shale; firm to friable yellowish-weathering gray sandstone and separating sandy gray shales (30%) 80
12. Covered 125

Top	Thickness in Feet
11. Sandstone with perhaps 30% purple-gray to brown-gray, sandy, lignitic shale and some laminated dark blue-gray shale; firm to friable, fine to medium-grained, ash-gray, yellow-weathering sandstone in beds averaging 1½ feet thick; many beds have ripple-marked upper surfaces	140
10. Shale and sandstone; predominantly dark blue-gray laminated shale with thin even-bedded sandstone layers; at top of zone about 5 feet of white, hard, ripple-marked sandstone	25
9. Alternating sandstone and shale in subequal proportions (ratio 6:4); sandstone is light gray, medium to fine-grained, poorly sorted, in well developed beds averaging less than 2½ feet and with some poorly developed ripple marks; dark gray to brown shale, the brown layers being sandy, lignitic, and containing many plant remains	135
8. Covered	35
7. About 50% of interval medium-gray, poorly sorted sandstone in beds up to 1½ feet, the units averaging 20 feet; separated by subequal amounts of dark blue-gray sandy shale; shale laminated with 1 to 3 inch beds of brown-gray lignitic sandstone	95
6. Shale and sandstone; blue-gray shales with thin laminae of silty, poorly sorted, fine-grained sandstone with intercalated medium-grained, brown-weathering sandstone; sandstone-shale ratio 6:4	37
Stanley shale	
Chickasaw Creek siliceous shale formation	
5. Shale; soft, dark gray to black when fresh, weathers light blue-gray; a few 1 to 4 inch beds of white siltstone and brown-gray poorly sorted sandstone	205
4. Siliceous shale; black laminated siliceous shale containing several thin beds of blue-black chert mottled with white almond-shaped siliceous areas; the weathered chert has a characteristic speckled appearance	3
3. Shale; poorly exposed, dark gray to black, laminated, weathers light blue-gray; includes some siliceous shale and some minor amounts of fine-grained ash-gray siltstone and sandstone	55
2. Siliceous shale; dark gray to black laminated siliceous shale with thin 1 to 3 inch hard, ash-gray siltstones comprising about 20% of the interval; dark blue-black chert in 1 to 3 inch bands, speckled with white siliceous areas	15
1. Dark blue gray to black laminated shale predominating (60-65%); fine-grained ash-gray sandstone in even beds up to 3 feet in thickness second in importance; sandy shale, 5%	55

Discussion of Section II

Post-Wesley formations

Rocks of Atoka and Morrow age are present above the Wesley shale in this part of the Lynn Mountain syncline but at this writing we have not identified with any degree of assurance Harlton's "Union Valley sandstone" or the Johns Valley shale. About 100 feet above zone 61 we have found sandstone float that contains molds of crinoid columnals and we suspect that the parent ledge correlated with the marine zone in the lower Atoka which contains Honess' "Morrow fauna."

Jackfork Group
Wesley shale formation

The shale described as zone 59 contains a green-gray weathering chert that permits a correlation with zone 101 of the Wesley shale of Section I.

Markham Mill and Prairie Mountain formations

Our studies are not sufficiently advanced to permit differentiation of Markham Mill and Prairie Mountain formations. Presumably the sandstones below the Wesley shale are Markham Mill in age and the base of zone 54 may be taken as the base of the formation. Using this arbitrary boundary, the underlying Prairie Mountain formation contains a noticeably high proportion of dark blue-gray shale with thin hard beds of quartzitic sandstone; the sandstone-shale ratio is roughly estimated to be 4:6.

Wildhorse Mountain formation

The interval assigned to the Wildhorse Mountain formation in Section II is about 3750 feet thick, a thickness comparing closely with the equivalent interval in Section I. In general, the lithologic succession is similar in both sections. Massive, fairly clean, quartzose sandstones are typical of the upper portion of the formation. The brownish-red shales of zone 30 are referred to the Prairie Hollow maroon shale member. The sandstones below the maroon shale tend to be poorly sorted subgraywackes.

Stanley Group
Chickasaw Creek siliceous shale

The fresh roadcuts reveal that a relatively high proportion of soft dark gray to black shale comprises this formation. This point is hard to determine in most natural outcrops. The thin layers of black chert with the white speckled areas of silica continue to characterize this formation.

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