
Petrified Wood in the Miocene Fleming Formation, Jasper County, Texas

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ABSTRACT

The stratigraphic occurrence of silicified fossil woods in outcrops is documented for a study area in northern Jasper County, Texas, south of the Sam Rayburn Reservoir. This area is located at the northern erosional termination of both the Pliocene Willis Formation and the Miocene Fleming Formation where they overlap the Oligocene to Lower Miocene Catahoula Formation.

The upper Catahoula Formation consists of hard, gray to white clayey siltstone and is eroded at the top. It does not contain fossil wood in the study area. The unconformity separating it from overlying formations has many tens of ft of relief over relatively short distances. The Fleming Formation overlies the Catahoula Formation and thins from about 50-70 ft (15-21 m) to wedge-out within the study area but thickens dramatically downdip. It consists of fine to medium clayey sandstone or sandy claystone with poor sorting and is typically mottled with masses of orange and gray clay, suggesting extensive soil formation on the sediments. The Willis Formation forms an unconformable cap on top of the Fleming Formation and consists of fine to coarse fluvial sandstone that is often iron-stained and cemented.

Petrified wood found in situ occurs within relatively narrow lenses of fluvial stream channels within the lower 10 ft (3 m) of the Fleming Formation. The wood varies from small pieces to large logs and typically has a small degree of rounding, indicating that it is not in the original fossilization location. However, the presence of large, intact logs indicates that it has not been transported far. Paleobotanical evidence corroborates this, indicating that the logs are either Miocene or Oligocene in origin. This suggests that the petrified wood may have been sourced either in the (now absent) uppermost Catahoula or the lowermost Fleming and that reworking of the sediments exposed and redeposited the fossilized wood.

INTRODUCTION

This study was conducted to document the stratigraphic context of silicified wood occurrences found in outcrops and is part of a larger project whose overall purpose is to document the occurrence of fossil woods in the Texas Gulf Coast Cretaceous and Tertiary. Much of the silicified wood collected in Texas is recovered as pieces that have weathered free from the source unit and stratigraphic data is generalized or not available. Specific objectives within this project include (1) identification of the taxonomy and range of these fossil woods, (2) assessment of paleoclimate using correlations between paleo and modern botanical species assemblages, and (3) assessment of environment of deposition for deposits containing silicified wood. This paper focuses on the geology of sediments containing petrified wood in the East Texas Miocene.

The study area is located in northern Jasper County, south of Sam Rayburn Reservoir (Figs. 1 and 2). This study area was chosen because petrified wood is abundant in the area but this wood is almost always seen as lag in modern day stream beds. To place this fossil wood occurrence in the proper stratigraphic context, a search was made for the source beds of the wood.

Silicified wood in this area is often inferred to be derived from deposits of the Catahoula Formation, but there is little documentation of occurrences in bedrock formations to determine if this concept is correct. Matson and Berry (1916) described the Catahoula Formation *Palmoxyton* from a locality very close to the present research site, but they admitted that all of their samples were found weathered out on the surface and immediately south of the Catahoula Formation outcrop. Chadwick (1988) clarified that fossil wood is found in the basal Chita Sandstone Member of the Catahoula Formation and in the basal Fleming Formation.

The current study has found that petrified wood found in situ occurs within relatively narrow lenses of fluvial stream channels within the lower 10 ft (3 m) of the Fleming Formation. The Onalaska Member of the upper Catahoula Formation does not contain fossil wood in the study area. However, in situ fossil wood in the lower Fleming Formation is sometimes fragmented and almost always exhibits a small amount of rounding. This suggests that fossil wood found as lag in the lower Fleming Formation channels is likely not in its original fossilization position and that it may have been fossilized in either the upper Catahoula or lower Fleming formations, weathered out, and redeposited without much lateral transport.

REGIONAL GEOLOGY

The Oligocene Houston Embayment (in the eastern portion of Texas) was the source of large volumes of clastic sediment (Galloway, 1977; Galloway et al., 2000). The Catahoula Formation in East Texas represents a transition from volcanic-rich South Texas sandstones and quartzose Louisiana sandstones. These sediments are mostly fluvial in origin (Paine and Meyerhoff, 1968). In East Texas, the Catahoula Formation is divided into two members based on lithology. The Lower Catahoula Chita Sandstone Member consists of coarse-textured gray to white sands (Scheldt and Ward, 1977). This unit is known to contain fossil wood (Chadwick, 1988). It is tuffaceous, and the volcanic glass in the sandstones is immature (unaltered) (Ledger et al., 1984). The upper Catahoula is called the Onalaska Member and consists of tuffaceous, bentonitic, pale olive to pale greenish yellow clays, siltstones, and fine sandstones (Scheldt and Ward, 1977). These authors concluded that these fluvial sandstones were sourced from other sedimentary rocks in northern Texas and southern Oklahoma.

In Texas, the top of the Catahoula Onalaska Member is placed just below the lowest occurrence of dark, calcareous clays of the Miocene Fleming Formation (Scheldt and Ward, 1977). However, this is in direct contrast with the stratigraphic definitions in Louisiana, where the upper Catahoula Onalaska Member is generally regarded to be equivalent to the Miocene Carnahan Bayou Member of the Fleming Formation (also light colored) and the lowest occurrence of dark, calcareous clays equivalent to the Dough Hills Member (AAPG, 1988; Hinds, 1999).

The Miocene is marked by a progressive shift in the depositional axes eastward into Louisiana (Galloway et al., 2000). The East Texas Miocene depositional axis, called the Newton Fluvial System, was an extension of the main Mississippi Embayment depocenter in Louisiana (Galloway, 1986). Sand body geometries in outcrop indicate the presence of meandering channels and crevasse splay deposits in a mixed-load fluvial system (Spradlin, 1980). Fossil wood has been documented from the basal portion of the Miocene Fleming Formation in northern Jasper County (Chadwick, 1988) and vertebrates have been found in Newton County (on the east side of Jasper County) that correspond to the Carnahan Bayou Member of the Fleming Formation in Louisiana (Albright, 1991).

Because of the thickness of Miocene outcrops in Louisiana, Fisk (1940) proposed dividing the Fleming Formation into 6 members based on transgressive/regressive sequence mapping: (from base to top) Lena Member, Carnahan Bayou Member, Dough Hills Member, Williamson Creek Member, Castor Creek Member, and Blounts Creek Member. These members represent relative changes in base levels, with the Lena, Dough Hills, and Castor Creek Members representing relative rises in the base flooding level and containing flood plain, lacustrine, and brackish water depositional environments. The Catahoula Formation, and the Carnahan Bayou and Williamson Creek members contain coarse-grained fluvial sediments interbedded with fine-grained flood plain sediments. They represent high-influx terrestrial units. (The Williamson Creek Member is thought to be equivalent to the Oakville Formation in South Texas, although they were deposited in different environments [Hinds, 1999]).

Texas Fossil Wood Localities

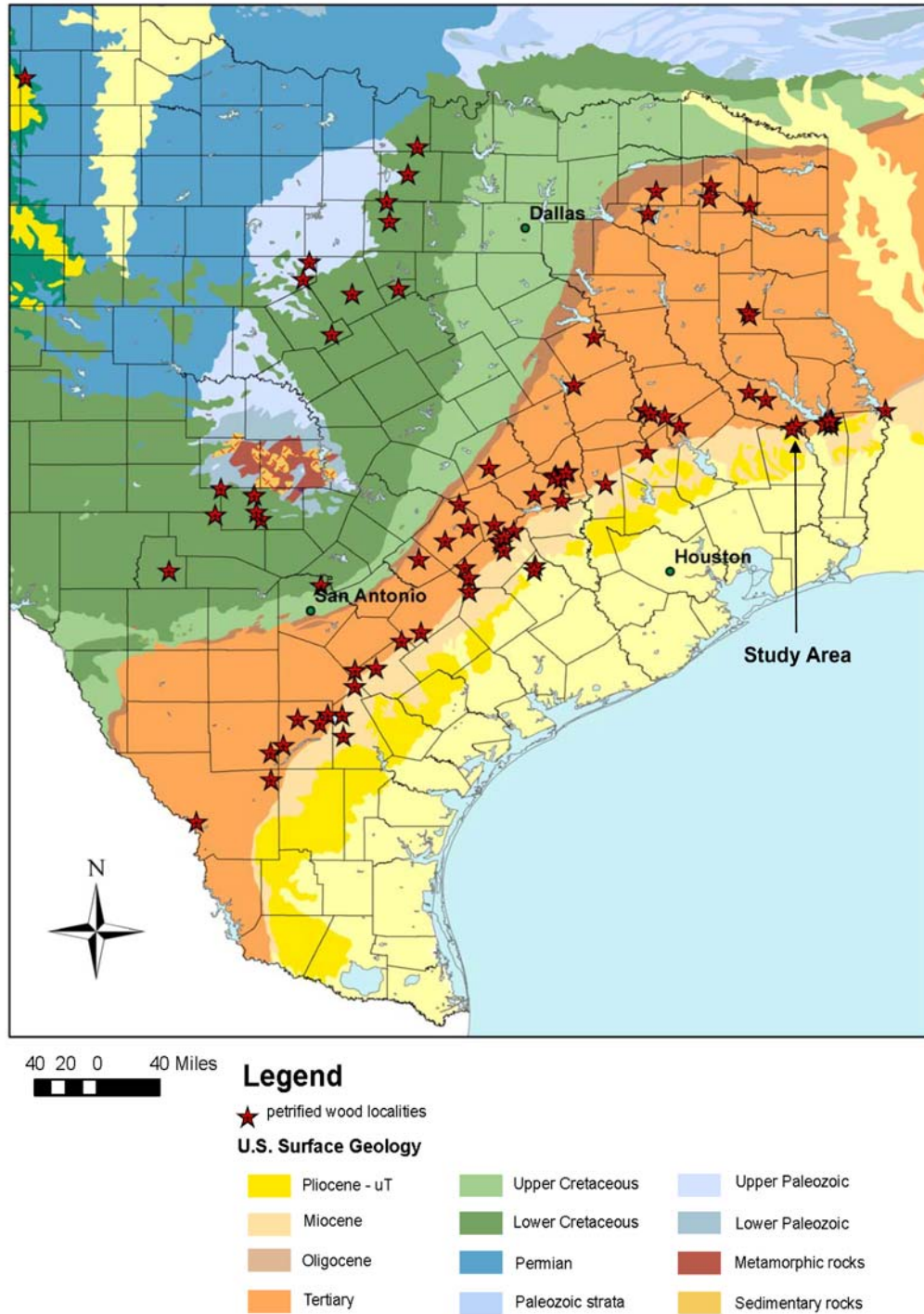


Figure 1. Regional surface geology map showing fossil wood localities in the fossil wood ID project. Geologic base map courtesy of the U.S. Geological Survey (see French and Schenk, 2007).

Jasper Fossil Wood Localities

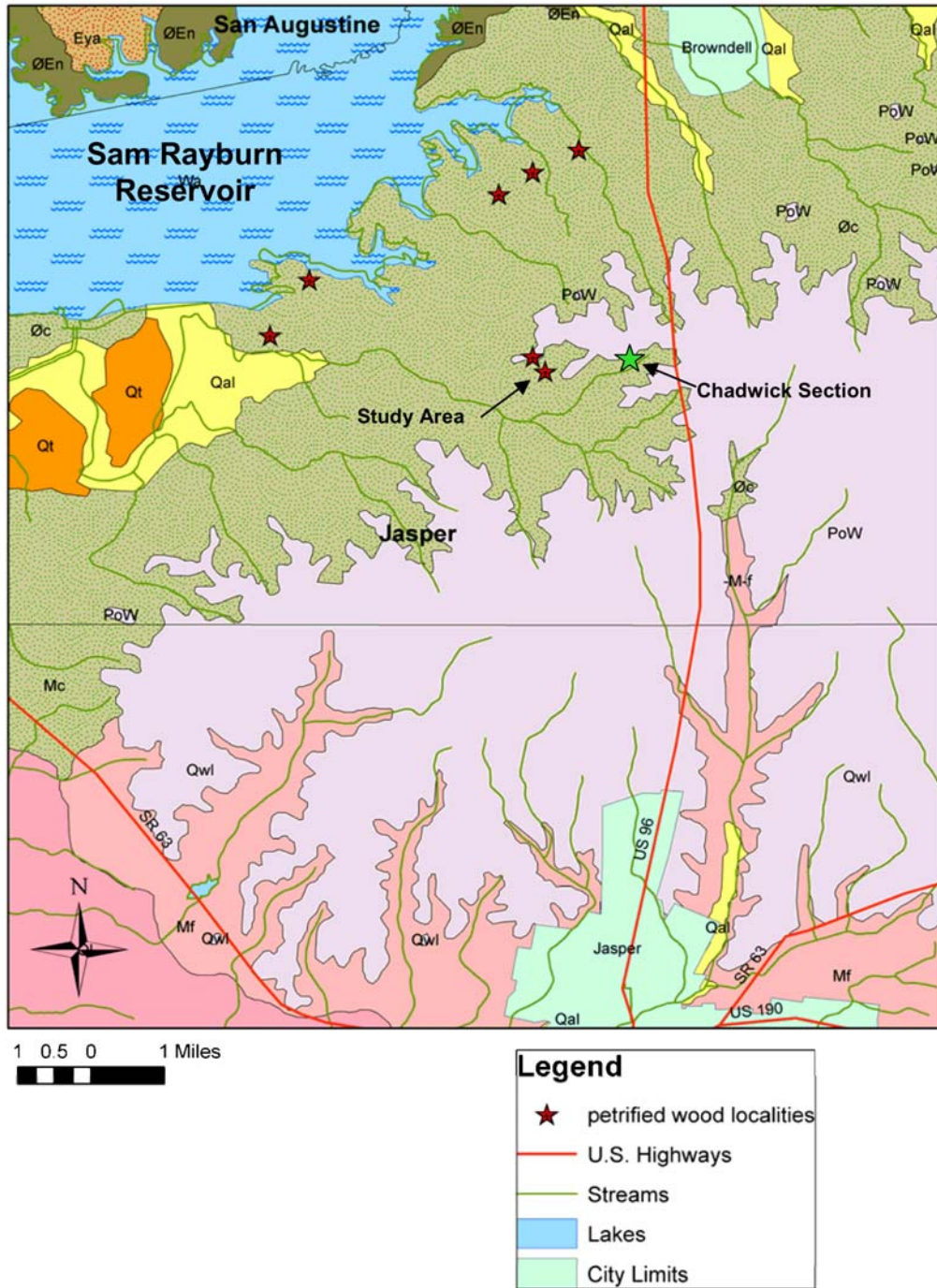


Figure 2. Surface geology map of the study area showing fossil wood localities in the Jasper area. Formation abbreviations are as follows: Yazoo (Eya), Nash Creek (OEn), Catahoula (Oc), Fleming (Mf), Willis (PoW or Qwl), fluvial terrace (Qt), and alluvium (Qal). Geologic base courtesy of TNRIS (2006).

METHODOLOGY

Field work over many years led to the selection of two transects for further evaluation. The first transect (called Transect 1) began at a stream bed where the contact between the Catahoula Formation and the overlying Fleming Formation was exposed. The transect was perpendicular to this stream, starting at stream-level and moving up the adjacent bank until reaching an adjoining hilltop. It allowed sediment sampling to take place from the uppermost Catahoula Formation, through the Fleming Formation, and into the lower portion of the Pliocene Willis Formation. Because a continuous exposure of this stratigraphic column was not possible, holes were dug at about 10-20 ft (3-6 m) intervals to extract samples of the sediment. These holes were dug about 1.5 ft (0.5 m) deep and 1 ft (0.3 m) wide, photographed, and samples extracted from the base of the hole. Measurement of hole location within the stratigraphic column was done via the Jacob's staff method.

The second transect (called Transect 2) was along the same stream bed. This stream's base closely paralleled the top of the Catahoula Formation for a considerable distance. The start of both Transect 1 and Transect 2 were at the same point in the stream bed. Exposures along the banks of this stream allowed this surface to be sampled and stratigraphic variations observed over a considerable distance. This transect was mapped and photographed. Measurement of changes in elevation along the transect was via the Jacob's staff method.

Sediment samples were examined with a Wild M7-S binocular microscope. They were photographed through an Optem eyepiece adaptor with a Canon PowerShot S5-IS. Calibration of grain size was obtained by the photography of a graticule at various magnifications. Samples were not screened for grain size.

RESULTS

Sediment sample descriptions from Transect 1 are given in [Table 1](#) and the resulting stratigraphic column is presented in [Figure 3](#). Site descriptions along Transect 2 are given in [Table 2](#). Additional details of important Transect 2 sites are given below:

U1: A section approximately 15 ft (4.6 m) long was excavated from the stream bank, exposing the Catahoula/Fleming contact ([Fig. 13](#)). Macroscopically the two formations could be distinguished by color and hardness. The Catahoula Formation is hard and blue-gray on a fresh surface, weathering rapidly to light gray, and the Fleming Formation is soft and medium gray to orange in color. However, close inspection revealed the presence of clasts of Catahoula Formation sediment within the basal 1-2 ft (0.5 m) of the Fleming Formation.

The formation contact undulates over the range of the excavated exposure, with the total relief of the contact being about 6-8 in (15-20 cm). Some of the relief was abrupt, with high-to-low distance being about a foot (0.3 m). Other portions had gentle slopes. This indicates that more significant relief might be expected.

U7 (3.5 ft vertical, 270 ft horizontal): This locality is the "big wood" site. Over a lateral distance of about 50 ft (15 m) several large trunks were lying partially exposed in or near the stream channel ([Fig. 14](#)). Exposed dimensions were about 5 ft by 1-2 ft in width (1.5 m by 0.5 m). A large number of smaller pieces were also lying scattered about.

One moderate-sized piece was excavated to determine the nature of the enclosing sediments that consist of mottled tan to orange, sandy clay. However, not enough section could be exposed to ascertain with certainty the position relative to the Catahoula Formation contact. Therefore, while the size and quantity of wood specimens indicates that the wood could not have traveled far, none of the wood at this site could conclusively be observed in situ.

U4 (10 ft vertical, 450 ft horizontal): This site contained a lenticular stream deposit with several large pieces of petrified wood as lag ([Fig. 15](#)). The dimensions of the deposit were 3.5 ft by 1.3 ft (1 m by 0.4 m). The fossil wood pieces filled the center part of the channel. Coarse sand, pebbles, and cobbles filled the remainder of the deposit, all encased in a medium to dark gray to orange clay. The left edge of the lens contained a 2 in by 2 in by 4 in (5 cm by 5 cm by 10 cm) piece of coarse, iron-stained sandstone whose outer surface was lithified with a thick black oxide coat. This sandstone material is of foreign origin because there are no known modern-day occurrences of this type of sand in this general area. The fluvial lens occurs about one ft (0.3 m) above the Catahoula Formation contact. The surrounding Fleming Formation sediments are light gray to tan to orange with some mottling.

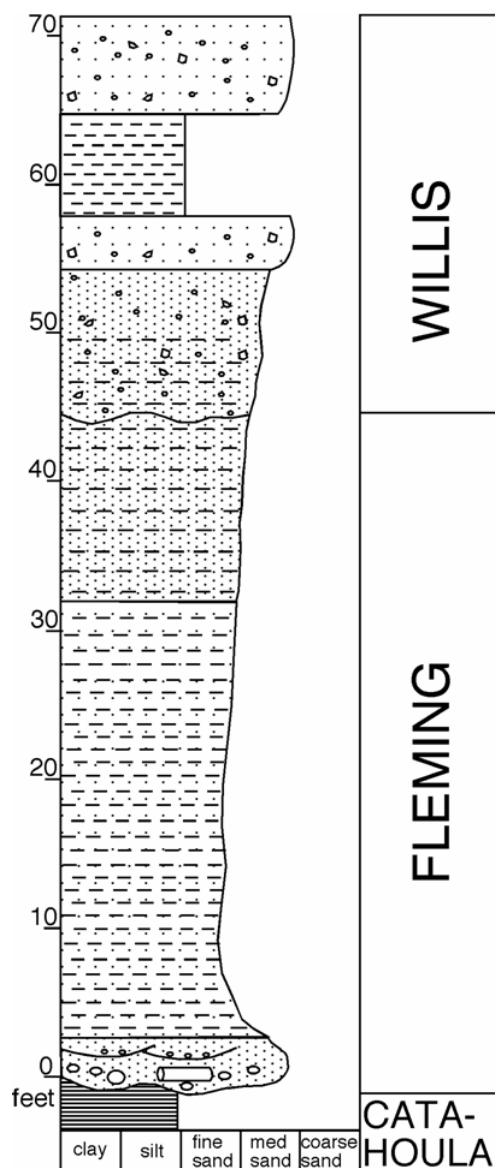


Figure 3. Stratigraphic column of the study area. Column created from sample locations along Transect 1.

DISCUSSION

The stratigraphic section measured at this locality bears a close resemblance to the Chadwick section measured about a mile (1.6 km) to the east (Fig. 16). The lowest Fleming Formation unit in the current study (the M1 sample) is similar to the sand described at the basal portion of Chadwick's section. Another common feature of the basal section is the presence of abundant petrified wood, some of which occur in lenticular pods of stream deposits. However, the M1 sample is not unconsolidated, as reported by Chadwick (1988), but is described here as "soft."

The upper Fleming Formation unit of Chadwick (1988, p. 71) is characterized by "red and yellow moderately sorted medium sand with pink and white clay clasts." This is identical to samples S3 through S6 (22-37 ft, 7-11 m). Chadwick (1988) reported petrified wood at the base of this unit and observations of this study supports

Table 1. Lithologic description of samples along Transect 1.

Sample #	Height (ft) / (m)*	Lithologic Description	Clay Color	Sand Description
C1	-1 (-0.3)	Siltstone; indurated, contains silt and clay laminae. Top of Catahoula Formation. (Fig. 4)	gray to whitish	quartzose
M1	0.5 (0.2)	Soft sandy mudstone; clay, silt, very fine and fine sand. Base of Fleming Formation. (Fig. 5)	light brownish-gray with orange mottling	quartzose, subangular to subrounded, moderately sorted
S1	13 (4)	Fine to medium grained, clayey sandstone (Fig. 6)	brownish-gray	quartzose, rounded to subrounded
S2	17.8 (5)	Fine to medium grained, sandy claystone	brownish with some streaks of orange	quartzose, subrounded to subangular
S3	22 (7)	Fine to medium grained, sandy claystone; sand is coarser than in S1 or S2	gray-brown with clasts of orange	quartzose, rounded to subangular
S4	26.5 (8)	Fine to medium grained, sandy claystone; harder than in lower samples (Fig. 7)	orange	quartzose, rounded to subangular
S5	33.8 (10)	Hard, fine to medium grained, sandy claystone	orange and gray mottled	quartzose, rounded to subangular
S6	37.3 (11)	Hard, fine to medium grained, clayey sandstone; sand content greater than in S5. (Fig. 8)	orange and gray mottled	quartzose, rounded to subangular
S8	45.8 (14)	Indurated, fine grained, clayey sandstone. Pebbles and pieces of petrified wood. Base of Pliocene Willis Formation. (Fig. 9)	orange-tan	quartzose, well sorted, rounded to subrounded
S9	51.9 (18)	Indurated, fine grained, clayey sandstone. Pebbles and pieces of petrified wood.	orange-tan, some white and red	quartzose, moderate to poor sorting, rounded to subrounded
S10	56.4 (17)	Indurated, fine to coarse grained, clayey sandstone. Pebbles and pieces of petrified wood. (Fig. 10)	orange-tan, only fills pores	quartzose, poorly sorted, rounded to subrounded
S12	58.3 (18)	Hard, silty claystone (Fig. 11)	light gray and red mottling	quartzose, small component of sample
S13	62.7 (19)	Hard, silty claystone, indurated	light gray, tan, orange, and red mottling	quartzose, slightly higher percentage than in S12
S11	65.1 (20)	Indurated, fine to coarse grained, clayey sandstone. Pebbles and pieces of petrified wood.	tan-orange	quartzose, moderate to poor sorting, rounded grains
S14	69 (21)	Indurated, fine to coarse grained, clayey sandstone. Pebbles and pieces of petrified wood. (Fig. 12)	tan-orange and red	quartzose, moderate to poor sorting, rounded grains

* Above top of Catahoula

Table 2. Description of sites along Transect 2.

Site #	Height (ft) / (m)*	Distance (ft) / (m)**	Description
U1	0 (0)	0 (0)	A section approximately 15 ft (4.6 m) long was excavated from the stream bank, exposing the Catahoula/Fleming contact. See text for description of section.
U8	2 (0.7)	150 (46)	Two pieces of fossil wood exposed on top of Catahoula Formation contact. The encasing sediments appeared to be similar to Fleming Formation, but contact with overlying soil zone not definitive, indicating possible recent sedimentation.
U7	3.5 (1)	270 (82)	"Big Wood Site" – several large trunks and a large number of smaller pieces lying in one particular locality. See text for description.
U6	5 (1.5)	300 (91)	Catahoula Formation contact at about 1.5 ft (0.5 m) above stream level.
U5	6 (1.8)	350 (107)	Catahoula Formation contact at about 5 ft (1.5 m) above stream level. Upper 1.5 ft (0.5 m) of Catahoula sediments were orange-stained, indicating possible subaerial exposure.
U4	10 (3)	450 (137)	Lenticular stream deposit 3.5 ft by 1.3 ft (1 m by 0.4 m). Several large pieces of fossil wood present as lag. See text for description.
U3	20.1 (6)	740 (226)	Catahoula Formation about 6 ft (2 m) above stream base. Lenticular stream deposit 18 in by 10 in (0.5 m by 0.3 m). Most of channel was filled with a single large piece of fossil wood. Several pieces of coarse, red sandstone were in and beside the channel.
U2A	35 (10.7)	850 (259)	Catahoula Formation contact still at stream base. Single ~5 lb piece of abraded fossil wood found within undifferentiated, orange and tan-mottled Fleming Formation sediments.
U2B	50 (15)	950 (290)	Catahoula Formation contact disappears under sediment cover, possibly representing a high point in the unconformable Catahoula Formation surface.

* Above top of Catahoula at U1 site

** Along transect starting at U1 site

this. The character of the basal Fleming Formation sediments above the Catahoula Formation contact changes laterally up the stream bottom sampled by Transect 2. The U7 “big wood” site, 270 ft (82 m) in lateral distance, has mottled orange and tan, sandy clay but is only 3.5 ft (1 m) above the base of the transect. The U4 site (10 ft or 3 m vertical), the U2 site (20 ft or 6 m vertical), and the U2A site (35 ft or 11 m vertical) all contain tan and orange mottled sandy clay or clayey sand along with in situ fossil wood. Therefore, it seems reasonable to suggest that the Fleming Formation sediments progressively buried highly irregular Catahoula Formation erosional topography (totaling 50 ft (15 m) within Transect 2), and that significant stratigraphic variations within Fleming Formation fluvial sediments should be expected. This, in fact, is what is observed in this study.

The Pliocene Willis Formation of Chadwick is also similar to that observed at the top of Transect 1. A basal hard sandstone unit, impregnated with red iron staining in the clay matrix, is separated by a clay layer at the top of the transect. Fragments of abraded petrified wood are distributed throughout these sandstones.

Strata at this locality can be tentatively correlated with stratigraphic units defined in Vernon Parish, Louisiana, (about 50 mi [80 km] away) by Hinds (1999) and McCulloh and Heinrich (2002). The Catahoula Formation, as defined in Texas, is included in the Lena and Carnahan Bayou members of the lower Fleming Formation in Louisiana. The Williamson Creek Member is the only fluvial-dominated member above the Carnahan Bayou Member. The Williamson Creek Member contains sediments similar in appearance to the underlying Dough Hills Member and the overlying Castor Creek Member, with the primary difference being the much higher percentage of coarser grain size in the Williamson Creek Member. The general description of these sediments is poorly sorted, grayish, clayey silt to medium sand with common reddish mottles. Very fine to fine, sandy clay, uniformly gray but with some red mottles, is also common in the Dough Hills Member, so it cannot be definitively ascertained based on sediment description alone which unit(s) of the Fleming Formation occur at the Jasper County locality. Based on sediment descriptions, however, it is reasonable to correlate the studied sediments to the Williamson Creek Member with possibly some component of the Dough Hills Member at the base of the unit.

At various places within the Willis Formation, larger pieces of petrified wood can be found weathering out of the hill slopes. About 50 samples of fossil wood were collected for identification. All but two of these pieces were live oak; the other two being members of the American elm group. Both of these wood types are similar to the dominant species in the Miocene Fleming Formation. All of this wood was highly abraded, unlike the Fleming Formation wood that only showed minor rounding on the edges of the specimens. This indicates this wood was weathered out of stratigraphically lower formations, possibly the Fleming Formation, and transported in one or more high energy streams before being redeposited.

SUMMARY

The stratigraphy and occurrence of petrified wood in northern Jasper County was described for the first time. Fossil specimens are slightly rounded and occur as lag in stream channels within the lower Fleming Formation. It is unknown where the wood originates, but by inference it is likely to be lower Miocene and has not been transported far from its original position. Abraded fragments of fossil wood also occur in indurated, higher energy Pliocene Willis Formation sands. However, it is likely this is lower Miocene material that has been excavated from its original resting place and transported some distance.

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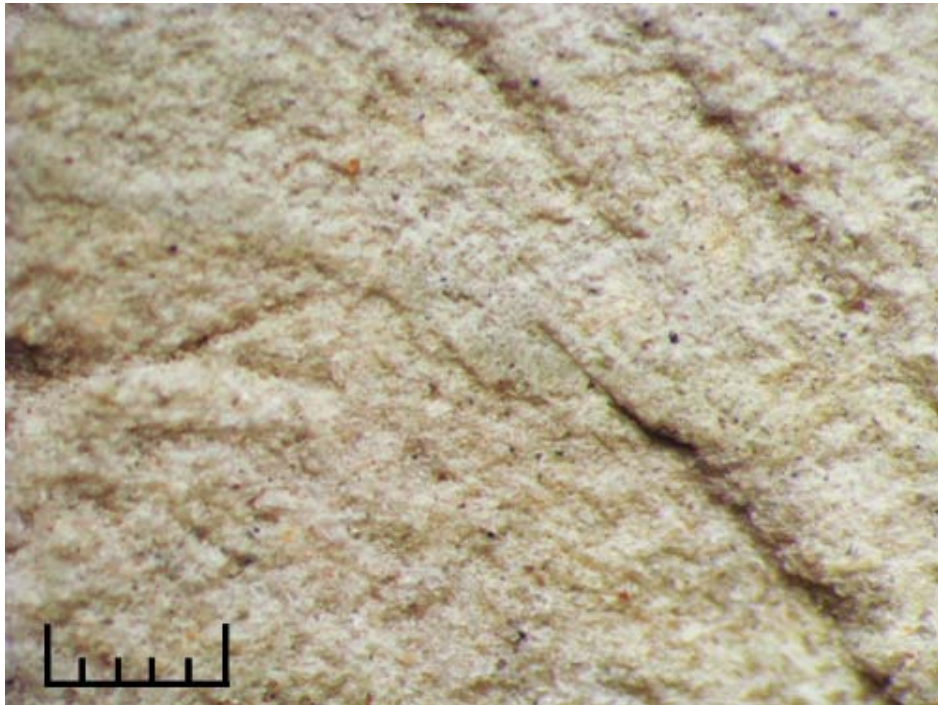


Figure 4. Microphoto of specimen C1 (Catahoula Formation). Bar is 1 mm.

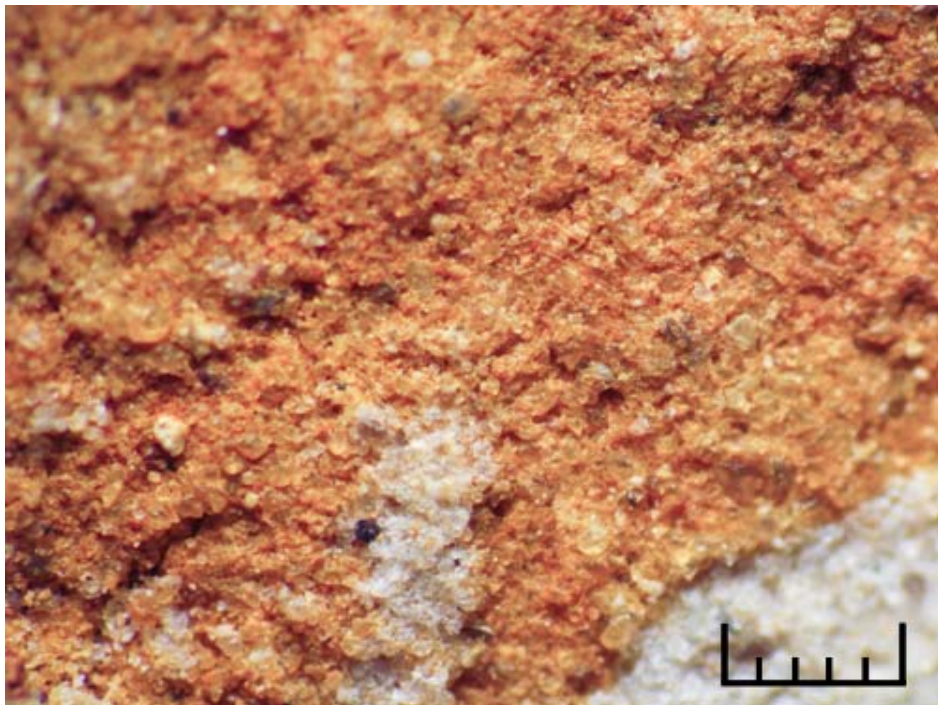


Figure 5. Microphoto of specimen M1 (Fleming Formation). Bar is 1 mm.



Figure 6. Microphoto of specimen S1 (Fleming Formation). Bar is 1 mm.



Figure 7. Microphoto of specimen S4 (Fleming Formation). Bar is 1 mm.



Figure 8. Microphoto of specimen S6 (Fleming Formation). Bar is 1 mm.



Figure 9. Microphoto of specimen S8 (Willis Formation). Bar is 1 mm.



Figure 10. Microphoto of specimen S10 (Willis Formation). Bar is 1 mm.

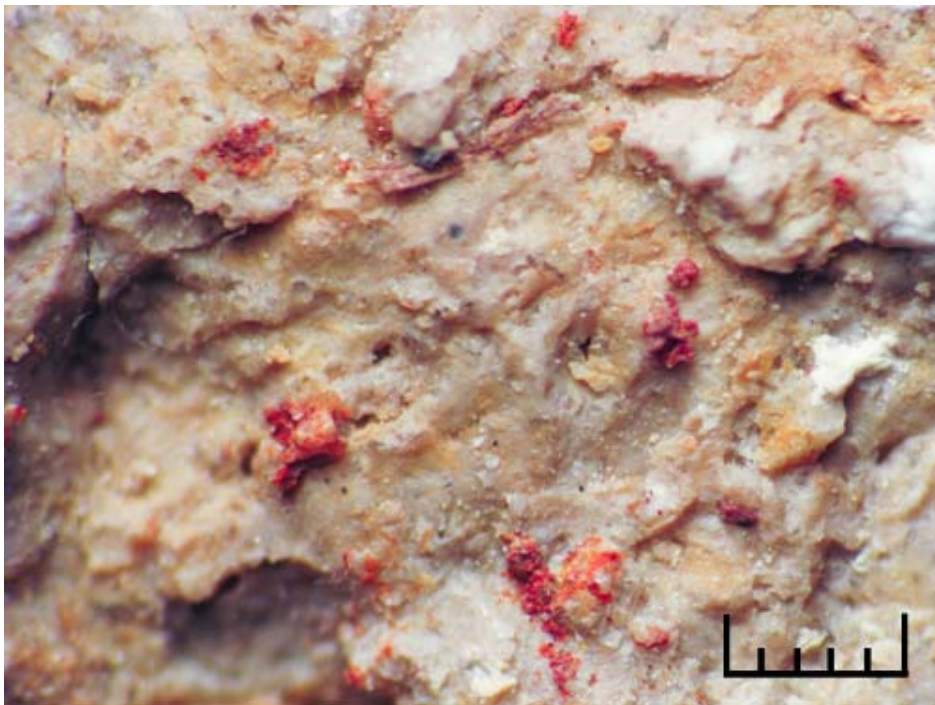


Figure 11. Microphoto of specimen S12 (Willis Formation). Bar is 1 mm.



Figure 12. Microphoto of specimen S14 (Willis Formation). Bar is 1 mm.



Figure 13. Catahoula Formation / Fleming Formation contact at the origin of both Transect 1 and Transect 2. Sample C1 and M1 were both taken from the area encompassed by this photo. Geologist pick handle is 13 in (33 cm) in length. Paint scraper is in the lower Fleming Formation.



Figure 14. Log partially exposed at locality U7. Ax handle is 25 in (63 cm) in length.



Figure 15. Lenticular stream deposit with large petrified wood pieces as lag. Black line indicates approximate outline of channel. Geologist pick handle is 13 in (33 cm), paint scraper is 7.5 in (19 cm). Pen indicates contact of Catahoula Formation with Fleming Formation. Black object at far left in channel is a piece of coarse red sandstone whose exterior has oxidized to black.

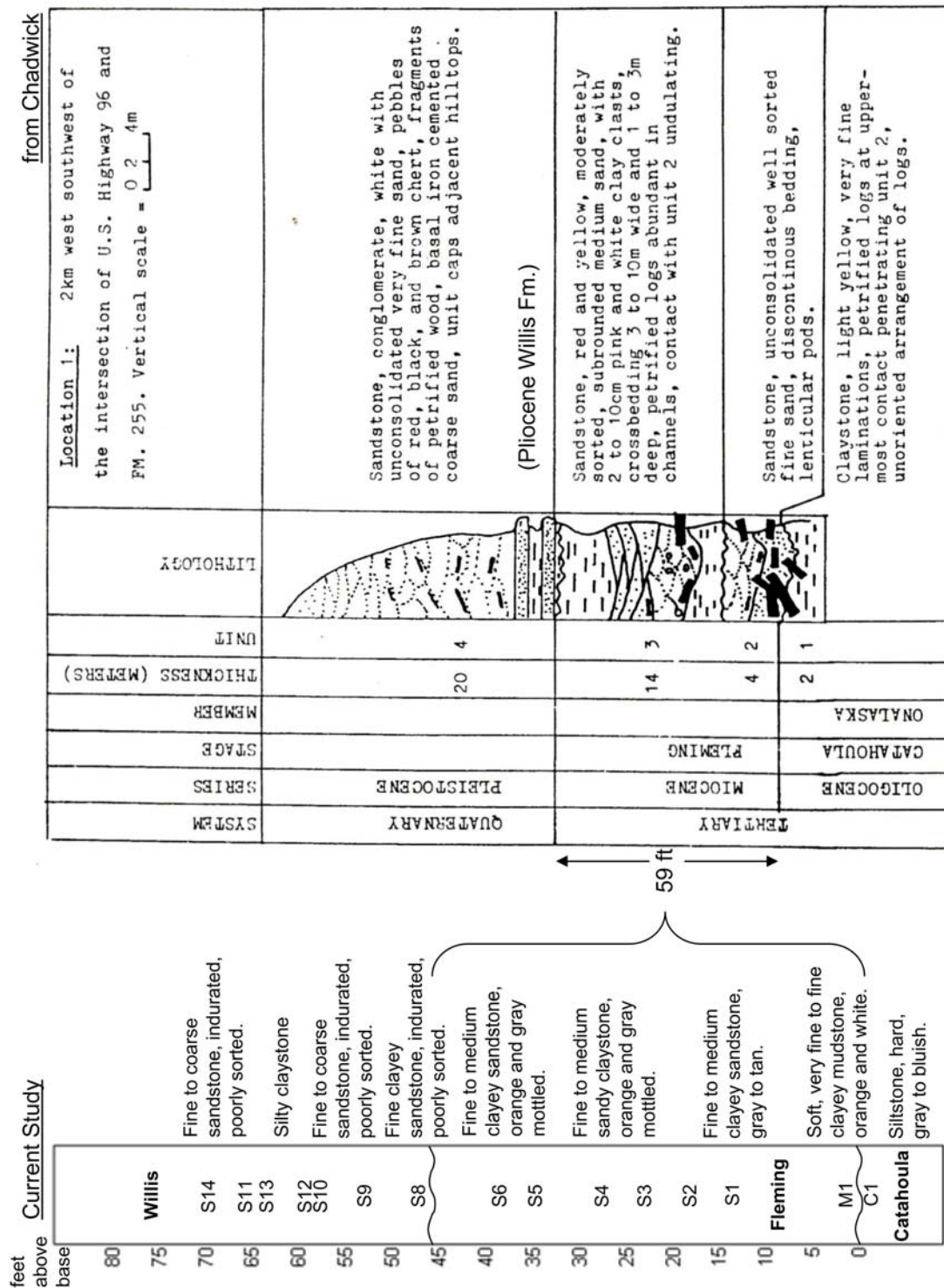


Figure 16. Chadwick's (1988) stratigraphic section (from about 1 mi [1.6 km] to the east of the current study) compared to a generalized stratigraphic description of the current study.

NOTES
