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VERTEBRATE COPROLITES FROM THE LOWER EAGLE FORD GROUP OF NORTH CENTRAL TEXAS AND THEIR PALEOECOLOGICAL SIGNIFICANCE

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Abstract—The Eagle Ford Group (Cenomanian-Turonian) outcrops extensively in Texas, from the Red River to the Rio Grande. Its thickness is variable reaching a maximum of about 183 m in North Central Texas and a maximum of about 15 m in Austin. West of Austin the thickness increases and is some 90 m in the Rio Grande region. The lithology of the Eagle Ford is variable at different levels. The lower Eagle Ford consists of the Tarrant Formation overlain by the Britton Formation. A coprogenic upper Cenomanian locality is described in the lower Eagle Ford Group of north central Texas. Even though the Eagle Ford Group has been the subject of geological research for nearly a century, there has been little study of the abundance and significance of vertebrate coprolites in the lower Britton Formation of this group. The new locality has yielded a great quantity of bone-bearing coprolites in a remarkable state of preservation. Many contain inclusions which are attributed to shark and/or large fishes due to their size, morphology, inclusions and also due to the fact that after the coprolites, the most abundant vertebrate fossils are shark as well as other fish teeth, vertebrae and other remains assigned to Cretoxyrhina, Squalicorax, Cretolamna, Enchodus, Ptychodus, Carcharias, Cretodus, Protosphyraena and saurodontids. Because of the abundance of coprolites, the outcrop strata are defined as coprogenic sediments. Coprolites horizons have a generally unrealized potential application in paleoecological reconstructions and in biostratigraphic correlation. Stratigraphically the new locality represents an important section of the Turner Park Member of the lower Britton Formation (lower Eagle Ford Group).The environment of deposition of the locality is interpreted as low-energy, offshore, poorly oxygenated environment. There is an abundant pelagic ichthyofauna, rare benthic invertebrate fauna and absence of infauna. It is consistent with the Oceanic Anoxic Event recorded during the late Cenomanian worldwide.

INTRODUCTION

Coprolites, from the Greek (*kopros*, excrement, and *lithos*, stone), are ichnofossils or trace fossils. As such, they reflect the activities and behavior of long extinct organisms, along with tracks, eggs, burrows, trails, nests. The term coprolite was originally proposed by Buckland (1829), who demonstrated that they were of fecal origin (Buckland, 1835). In the field, coprolites are often confused with concretions. However, coprolites can be distinguished by a combination of some or all of the following features: (1) extrusive external morphology e.g. spiral; (2) internal structure is ordered, e.g. spiral or with longitudinal canals; (3) longitudinal or spiral external striations; (4) similarity of morphology to animal guts; (5) morphology reflecting ranges of viscosity in modern fecal matter; (6) flattening of ventral side; (7) inclusions of organic matter; (8) presence of evidence of gas bubbles or gas-escape structures; (9) composition of calcium phosphate; (10) very fine-grained matrix (Amstutz, 1958).

Coprolites along with other trace fossils are excellent aids as environmental indicators often providing information where body fossils are scarce or absent. Under certain sedimentological conditions, the fecal remains of organisms can become fossilized. In some outcrops, these trace fossils are more abundant than vertebrate body fossils. They have potential as paleoenvironmental indicators and stratigraphic markers. Due to the initial consistency (hard, formed, loose, or watery) of animal feces, most of them will not become fossilized. Specifically, in a marine environment feces must have a certain degree of viscosity and integrity to be ultimately preserved as coprolites.

Coprolites display a wide variation of forms and these can vary even within feces from a single individual. As this study shows, there are certain guidelines that can be used to identity the producer. Coprolites display a wide range of colors from black, brown, reddish, orange, gray, to some even with a lavender color. Coprolites also vary in degree of petrification. Some are light in weight and porous, while others are more indurated. The majority of coprolites are phosphatic, with lesser numbers being calcitic and a small percentage being sideritic or siliceous. All of this is affected by diagenetic variability, depending on the sedimentological as well as paleoenvironmental factors where the feces where first deposited.

The size of the coprolites is another important feature, since it can provide information about the possible animal producers. There are what I refer to as microcoprolites (i.e. fecal pellets of few millimeters in length). There are also coprolites of few centimeters, to presumed dinosaurian coprolites of several decimeters in length. Regardless of the animal producer of the coprolite, during the digestive process, most food ingested will be thoroughly processed and this may become part of the ground mass of the coprolite. However, sometimes, depending on the animal producer, part of the food (i.e. bony parts, teeth, scales, woody plant material) will remain relatively intact and will be excreted in the feces. The identification of such remains provides clues as to trophic interaction between the producer organism and its paleoecosystem.

This paper describes the occurrence of exceptionally well-preserved coprolites in the lower Eagle Ford Group, Britton Formation, Turner Park Member of north-central Texas. The locally abundant well-preserved coprolites provide information not only about paleoecological reconstruction but have a definitive application in biostratigraphic correlation. The following abbreviation is utilized in the text: NMMNH refers to New Mexico Museum of Natural History and Science in Albuquerque.

GEOLOGICAL SETTING

The Eagle Ford Group (Cenomanian-Turonian) is extensively exposed in Texas, forming an outcrop belt across the entire state from the Red River to the Rio Grande. It crops out from northeastern Texas, towards the south through Dallas, Waco, Austin and San Antonio (Dawson, 1997; Fig. 1). The thickness is variable, reaching a maximum of 152 to

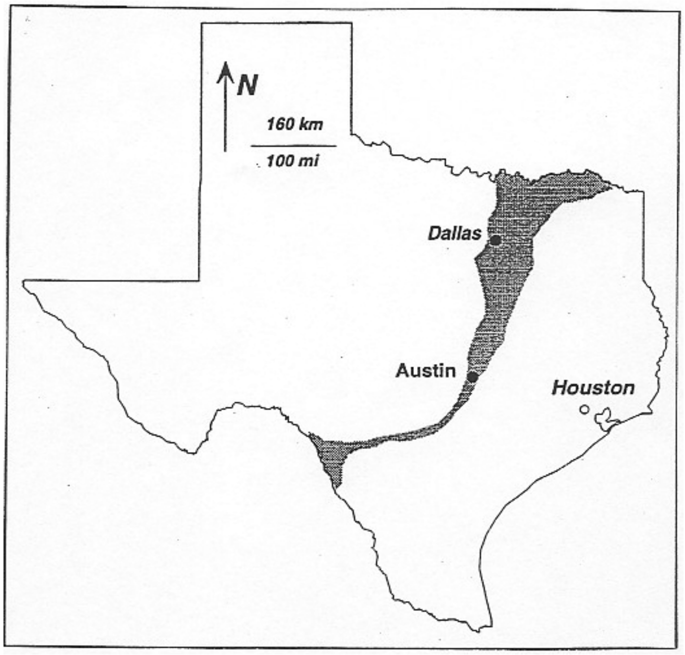

FIGURE 1. Map showing Cretaceous outcrops in eastern Texas (after Dawson, 1997).

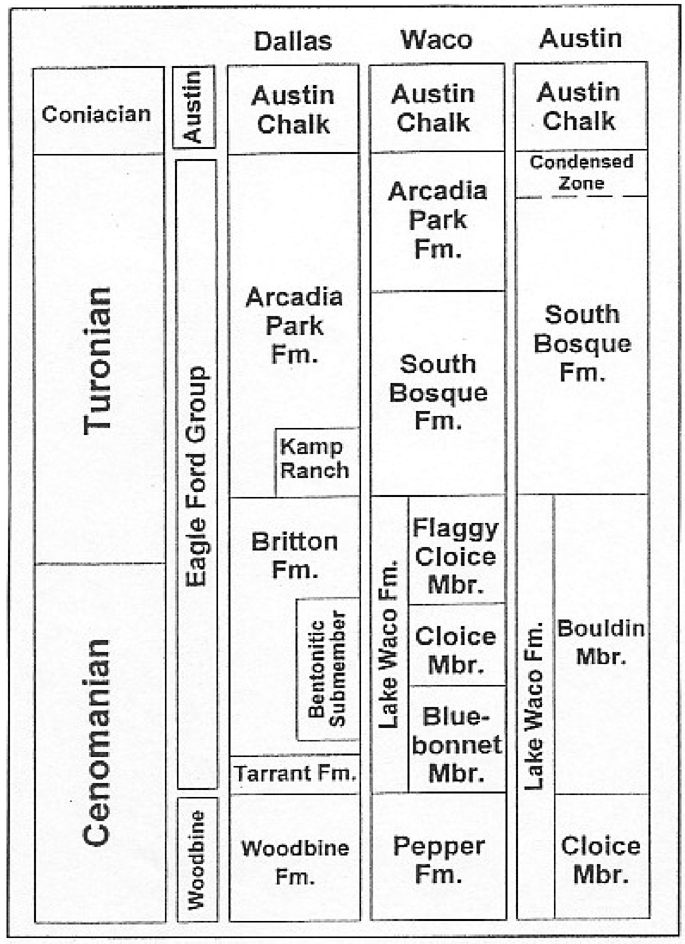

FIGURE 2. Middle Cretaceous strata in northern and central Texas (after Dawson, 1997).

183 m in North Texas between Dallas and Sherman, while at Austin it is only about 15 m thick. West of Austin, the thickness increases and is some 60 to 90 m in the Rio Grande region (Moreman, 1927). The decreasing thickness southwards from the Red River is probably due to a gradual disappearance in that direction of the lower beds until, at Austin, only the upper part of the group is represented. The lithologic character of the Eagle Ford variable, but generally consists mainly of bituminous shales (Moreman, 1927).

The lower Eagle Ford consists of the Tarrant Formation overlain by the Britton Formation. The Britton is mostly composed of shales which range from 76 to 90 m thick and are predominantely blue in color with a few flaggy limestone seams at the top of the unit. The lower section of the Britton contains numerous bentonite seams. Powell (1970) informally divided the Britton Formation in the Dallas area into a lower calcareous (chalky) unit and an upper noncalcareous unit separated by a thin "transition zone" (Powell et al. 1970). Later Powell and Reaser (in Reaser, 2002) formally subdivided the 112 m-thick formation into two members: the lower Turner Park Member, equivalent to the calcareous unit, and the upper Camp Wisdom Member, equivalent to the noncalcareous unit.

The Turner Park Member consists mostly of dark gray and light-yellowish brown calcareous shales with numerous bentonite seams. The bentonites were formed by a succession of volcanic eruptions during early Britton deposition. The age of the Turner Park is late Cenomanian. The Camp Wisdom Member is composed mostly of olive-gray shale (Reaser, 2002). This member is distinguished in outcrop by its ocher, calcareous clay-ironstone nodules and gray septarian concretions in dark olive gray shale. The age of the Camp Wisdom ranges from late Cenomanian to earliest Turonian (Reaser, 2002).

In most areas the Britton Formation is disconformably overlain by the Arcadia Park Formation (Fig. 2). A stratigraphically superjacent regressive limestone, known locally as the Kamp Ranch Limestone, overlies the Britton Formation in some outcrops in the vicinity of Dallas (Dawson, 1997). The Eagle Ford Group records a second order transgression and contains a major (third order) condensed interval. The Eagle Ford records mixed siliciclastic/carbonate deposition during the Late Cretaceous (Cenomanian/Turonian) transgression on the Texas craton (Liro et al., 1994).

The Cenomanian/Turonian boundary (92 ma) occurs within the Eagle Ford Group. Detailed analysis of the Eagle Ford outcrop in central Texas reveals considerably variability at several different scales. The lower section is interpreted to represent transgressive, in part "condensed" deposits, whereas the overlying section is interpreted as a highstand deposit. These two depositional units have distinctive sedimentological and geochemical characteristics (Dawson, 2000). The Eagle Ford is generally unconformable with the underlying Woodbine sediments and is overlain disconformably by the Austin Chalk (Fig. 3).

The measured section at the study area consists of 9.8 meters of thinly laminated buff colored to yellowish and orange clay shales or mudstones intercalated with platy limestones (foraminiferal grainstones) and bentonitic clays throughout the locality (NMMNH locality 5218). The entire section contains an unusually abundant vertebrate ichnofauna as well as numerous body fossils, dominantly fish remains. The coprolite material occurs mostly in a horizon 1.8 to 2.9 m above the base of the measured section (Fig. 4). Ironstone nodules occur abundantly throughout the entire outcrop. Numerous caliche nodules, which are similar in appearance to the coprolites, top the outcrop.

AGE AND ENVIRONMENT

Vertebrate coprolites are abundant in the newly discovered outcrop under study of the Britton Formation Turner Park Member of the lower Eagle Ford Group in north-central Texas (Friedman, 2001, 2002: NMMNH locality 5218). Sediment samples were examined for the presence of biostratigraphic foraminiferal marker species (Rotalipora cushmani-greenhornensis) and were dated as late Cenomanian following the zonation of Pessagno (1969). Biostratigraphic marker species are rare at this

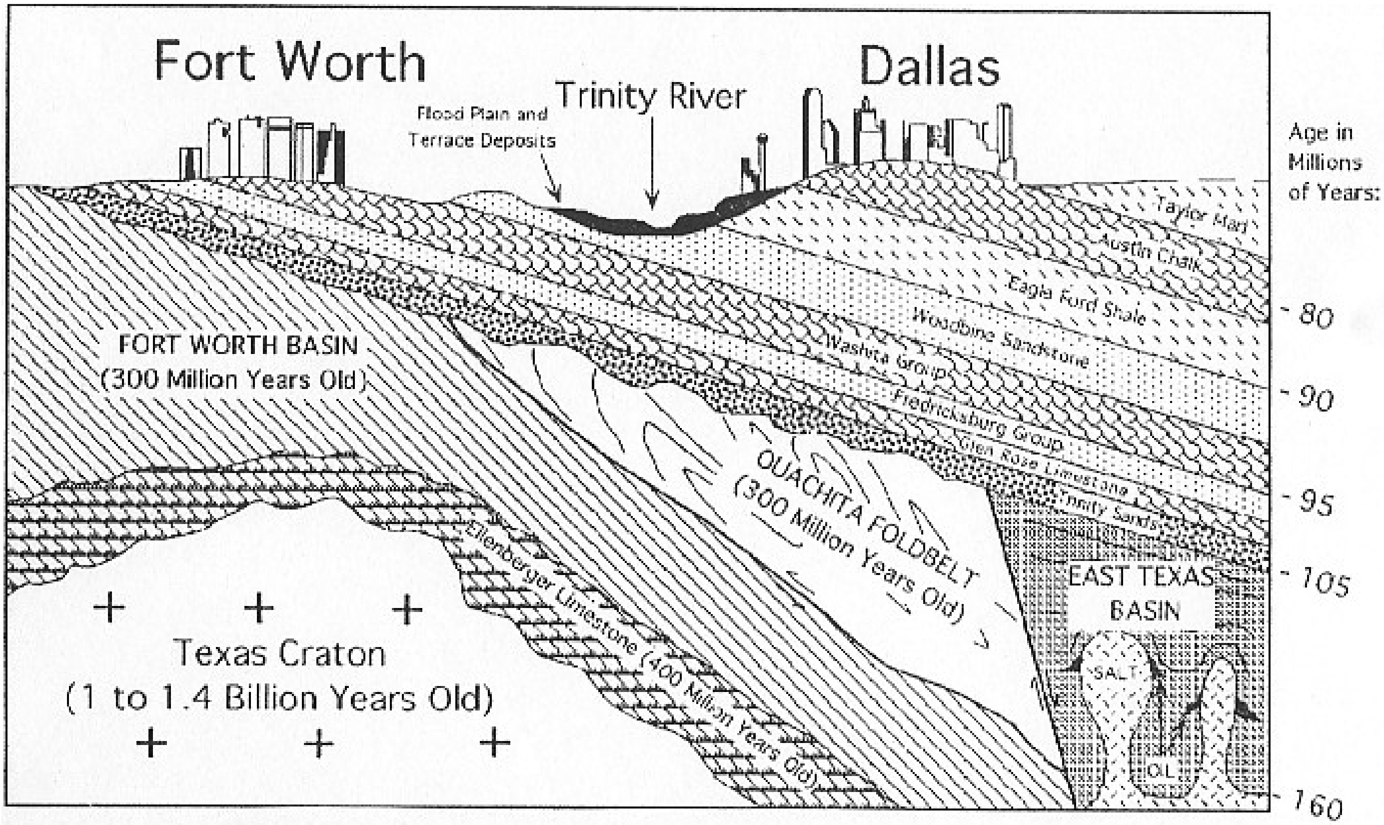

FIGURE 3. Generalized geologic cross section of the Dallas-Fort Worth area.

locality, probably due to dysoxic/anoxic conditions in a stratified water column. The microfaunal assemblage is dominated by long-ranging planktic globular foraminifera (hedbergellids i.e. very abundant Hedbergella brittonensis, H. delrioensis, H. amabilis, H. sp.) and by the biserial planktic foraminifer Heterohelix moremani. The latter is regarded as a small-sized opportunist with a long biostratigraphic range (Nederbragt et al., 1998). An abundance of these forms have been related to extremely variable surface water conditions as in shelf seas or in upwelling areas or have been interpreted as indicative of the presence of an intense oxygen minimum zone (Nederbragt et al., 1998). These epipelagic foraminifers have been described as shallow-marine opportunistic organisms able to survive in stressed environmental conditions (Nederbragt et al., 1998; Gasinski, 1997). Micronutrient availability was also somehow restricted, as indicated by the low species diversity of the assemblage. The ratio of pelagic (nektonic and planktic) to benthic organisms is notable. There is an absence of benthic foraminifera and the micro assemblage is entirely planktic. This is another indication that the bottom sediments were most likely anoxic creating an environment unsuitable for the benthic foraminifera to inhabit. Poorly-oxygenated conditions prevail during the entire Eagle Ford deposition as well as general absence of infauna and a marked high ratio of pelagic to benthic organisms. This paleoenvironment can be observed in a macro and micro scale in the entire outcrop as well as in many others (Personal observation of author). The sediment samples were dated also by calcareous nannoplankton refining the age as latest middle Cenomanian to early late Cenomanian (mid-late Cenomanian) (D.K.Watkins, pers. comm. 2001).

DESCRIPTION

Over 600 vertebrate coprolites were collected. Many are complete, others are just fragments. These specimens were recognized as coprolites on the basis of internal and external morphology, mineralogy and inclusions. All the coprolites present a “greasy”, “powdery” and chalky texture. They weather out easily from the surrounding calcareous matrix (Fig. 5) and s a result, the external morphology of most coprolites is clearly visible and excellently preserved.

Studies on coprolites are based mainly on external features and, in this study, thin sections were also prepared (Figs. 6-8). The fine-grained groundmass of the coprolites does not react with diluted HCL (10%) as the surrounding matrix readily does. The presence of bone inclusions suggested also a phosphatic chemical composition. Based on thin section petrography as well as X-ray diffraction analysis (XRD) (Rigaku automated powder Diffractometer) the mineralogical composition of the coprolites is primarily apatite. Minor mineralogical constituents are quartz and calcite, rare goethite, illite and mica, which are probably contaminants from the surrounding matrix. The specific gravity of the coprolites ranges from 2.6 to 2.9 g/ml. Since the specific gravity of apatite is from 3.1- 3.2 g/ml, the discrepancy between the apatite density and the density of the coprolites is most likely due to the porosity that many coprolites exhibit. The coprolites color was measured dry (Goddard et al., 1980). The coprolites range in size from 1.1 to 4.5 cm in length and are assigned to 7 morphotypes: discoidal, ovoid, oblong, elongated, spherical, folded and amorphous. A random sample of 50 coprolites is described for this study (Fig. 9; Table 1.) All of the coprolites analyzed are housed in the collections of NMMNH (catalog numbers 37764 to 37784 and from 37837 to 37865). The coprolites contain semi-articulated and disarticulated fish remains within a very fine-grained groundmass. Their content is dominated by undigested fish remains belonging to different taxa. The inclusions are small vertebrae and assorted bones of generally unidentified fishes, but Enchodus palatine teeth and pachyrhizodontids fin fragments have been identified within the coprolites. No coprolite was found to contain shark teeth or any invertebrate material. All coprolites contain marine faunal remains and no non-marine inclusions were found.

INTERPRETATION

Many of the coprolites have thin spiral striations and folds. Primi-

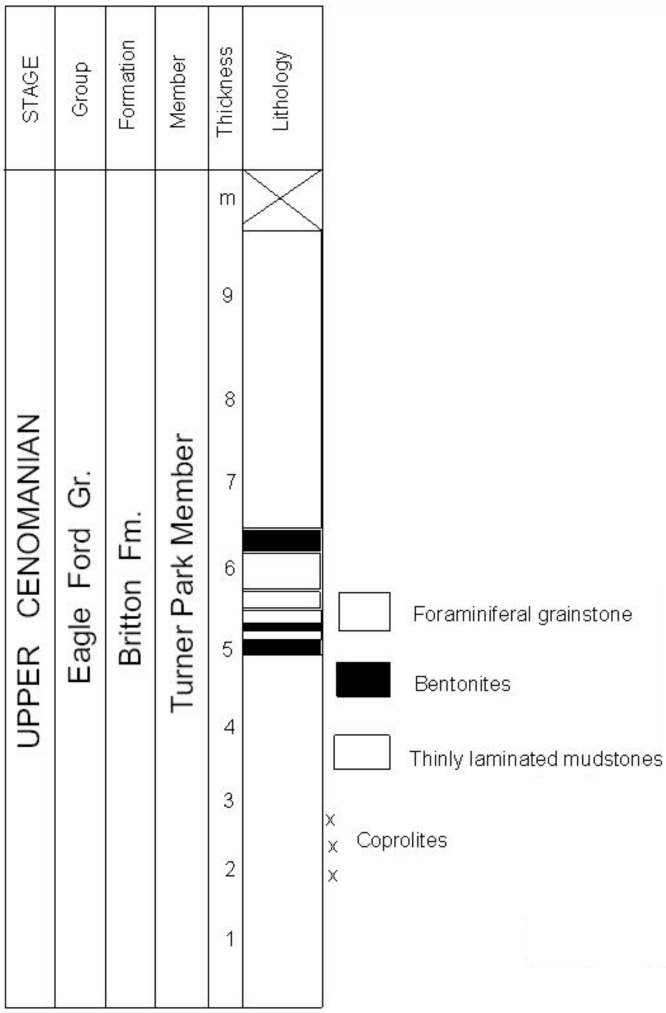

FIGURE 4. Measured section of the new locality of the lower Eagle Ford Group showing coprolites horizon.

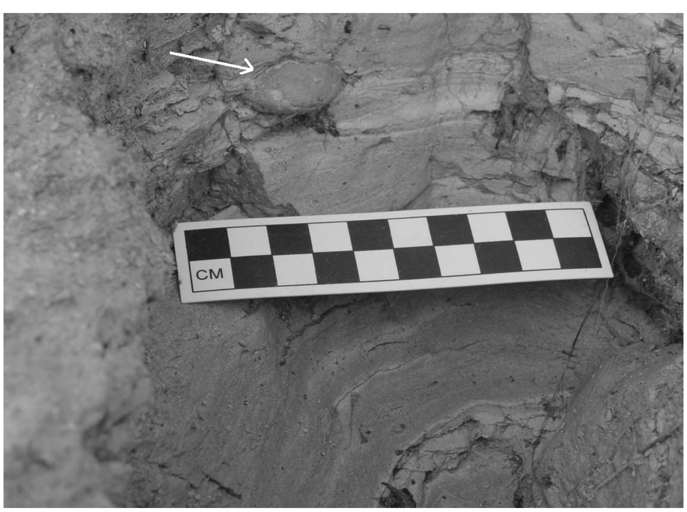

FIGURE 5. Coprolite *in situ*.

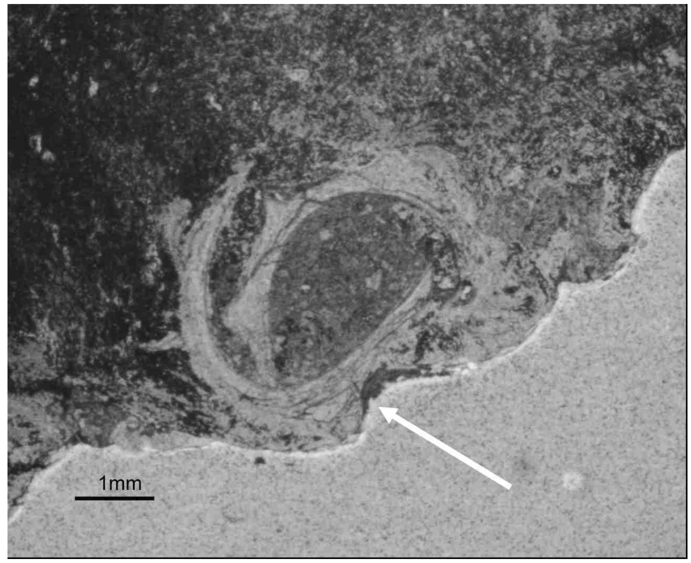

FIGURE 6. Transmitted light photomicrograph of coprolite thin section showing fish vertebra.

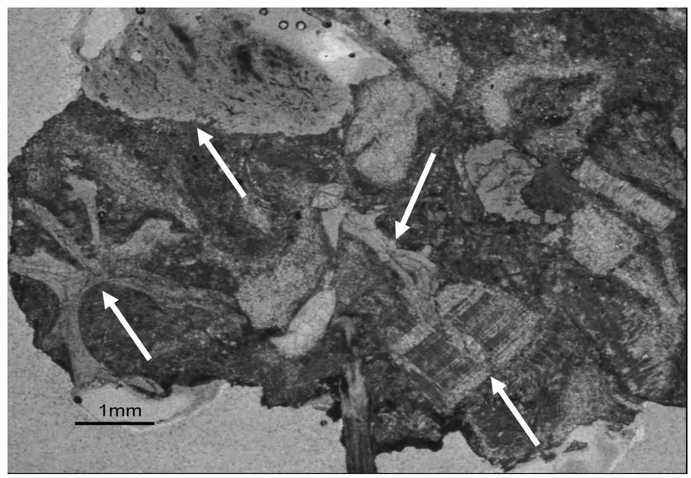

FIGURE 7. Transmitted light photomicrograph of coprolite thin section showing numerous fish bone fragments (1-3) and inoceramid calcite prisms (4).

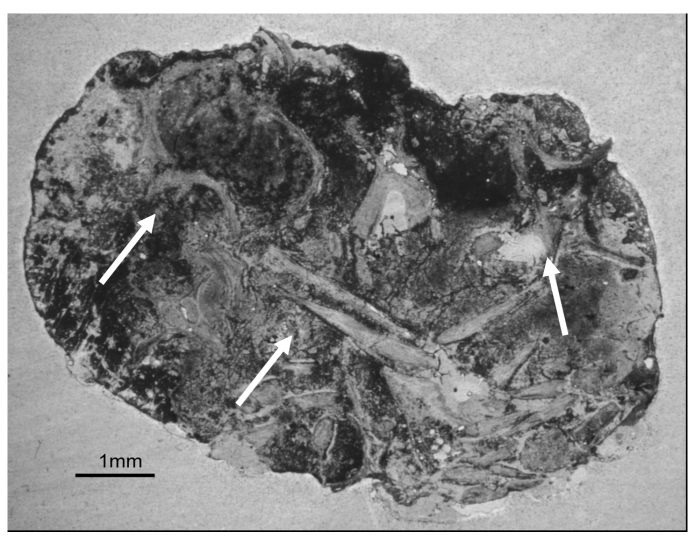

FIGURE 8. Transmitted light photomicrograph of coprolite thin section showing abundant fish bone fragments.

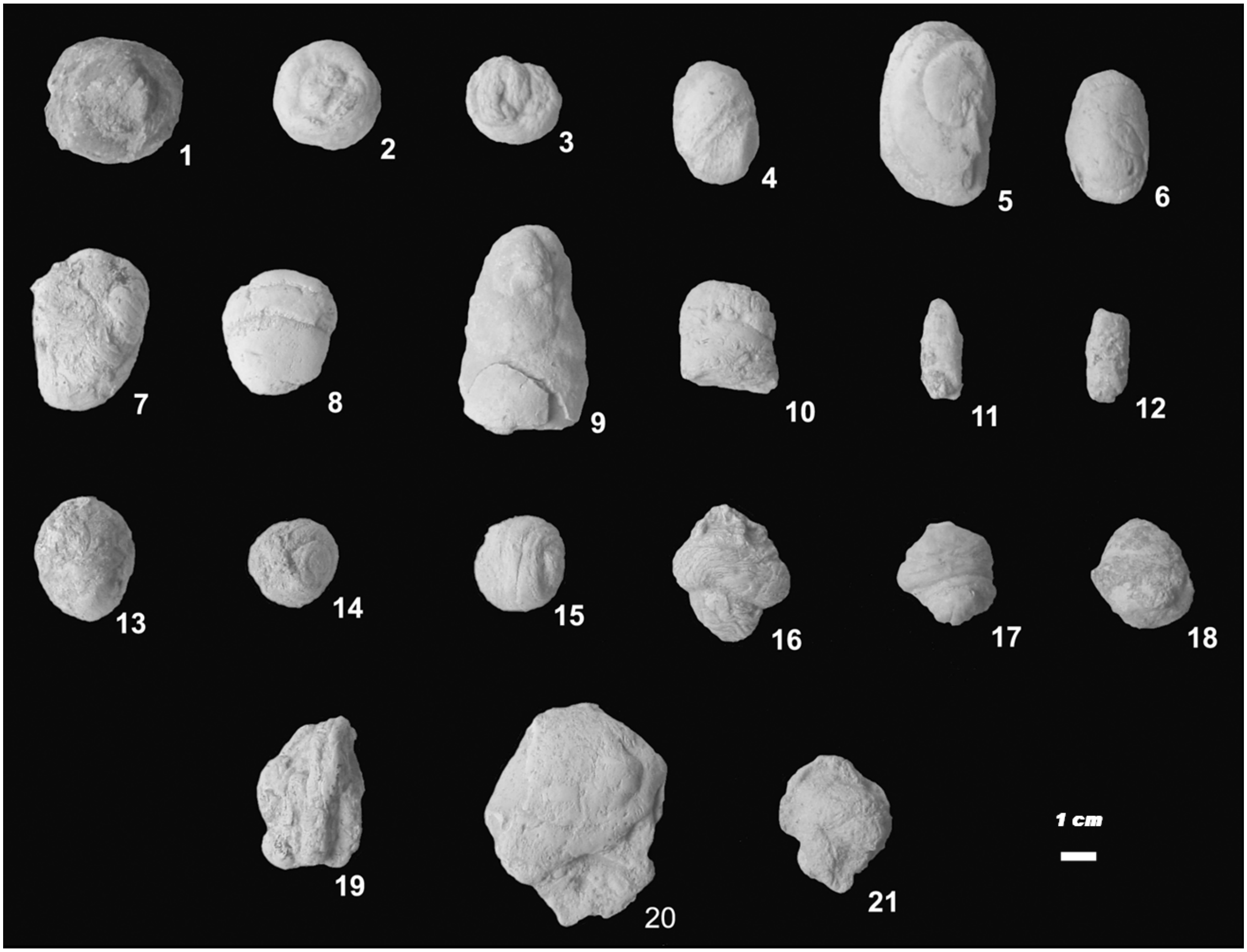

FIGURE 9. Coprolite morphotypes (**1-3**, discoidal; **4-6**, ovoid; **7-9**, oblong; **10-12**, elongated; **13-15**, spherical; **16-18**, folded; **19-21**, amorphous).

tive fishes including sharks, gars and lungfishes possess spiral intestinal valves (Gilmore, 1992), hence the coiled shape of most of the coprolites. The spiral valve is absent in teleosts fish (Romer and Parson, 1986). Under favorable conditions the form of the feces retains external morphology which are characteristic. The greater the number of chambers in the intestinal valve, the greater the number of coils in the feces (Price 1927). In sharks, the valve is a sheet of tissue that increases the surface area of the intestine for more efficient absorption of food. The exact form of the valve is different in the various major groups of sharks. The more primitive form (e.g., in many lamniforms) is called a spiral valve because the valve coils like an auger. More advance sharks (e.g., many carcharhiniforms) have a valve that is rolled like a scroll. As food passes through the intestine unabsorbed material is molded by the valve. Coprolites from a spiral valve have a closely spaced spiral groove, while those from a scroll valve have a folded appearance. Other sharks have loosely coiled valves that produce coprolites of intermediate form (i.e. with a very widely spaced spiral groove) (Kent, 1994).

Most of the coprolites (75%) collected in the lower Britton Formation exhibit a spiral or coiled morphology. These bone-bearing coprolites are attributed to sharks and/or other fish, due to their morphology (spiral or scroll-folded), inclusion content and due to the fact that after coprolites, sharks and other fish remains (teeth, vertebrae, fins, etc.) are the most abundant body fossil found in the faunal assemblage of the Britton Formation.. The coprolites (25%) that do not exhibit spiral folding or striations may have undergone severe weathering: either the outer layers were removed by weathering or spiral folds were originally absent. If these coprolites are unweathered they may have been produced by teleost fishes that lack spiral valves in their intestines. The ichthyofauna of the locality is multitaxic and it includes the following genera: Cretoxyrhina, Squalicorax, Cretolamna, Carcharias, Enchodus, Ptychodus, Protosphyraena, Xiphactinus, Pachyrhizodus, as well as the oldest saurodontid record in North America (Stewart and Friedman, 2001). Reptilian remains have also been found belonging to plesiosaurs, turtles, as well as the enigmatic and rare Coniasaurus.

The invertebrate material recovered from the locality is very low in diversity. Large shattered in situ inoceramid bivalves are found throughout the lower part of the outcrop at approximately 1.2 m. Only three incomplete ammonites (Metoicoceras sp.) were collected. Inoceramids are known to have showed a wide distribution indicating a broad tolerance for variations in the benthic environment. Inoceramids favored basinal fine-grained facies with dysaerobic oxygen levels (Kauffman, 1990). Coprolite horizons are important in paleoecological reconstructions but also in biostratigraphic correlation (Price, 1927; Johnson, 1934; Hunt et al, 1993). Future work will include biostratigraphic correlation of this coprolite horizon in 12 new potential outcrops of the lower Britton Formation in north central Texas.

CONCLUSIONS

1. The bone-bearing coprolites of the lower Eagle Ford Group are attributed primarily to sharks and/or other primitive fishes, due to their

TABLE 1. Coprolites Description (All measurements for length and width are in mm, for weight in gr. Color was measured using Rock Color Chart). All specimens are from NMMNH 5218 locality, catalog numbers NMMNH P-37764 to P-37784 and from P-37837 to P-37865.

NMMNH SPECIMEN NUMBER	LENGTH	WIDTH	WEIGHT	COLOR	MORPHOTYPE	INCLUSIONS	REMARKS	FIGURE
37764	31.7	29.3	11.5	Light brown 5YR 5/6	Discoidal	Rare	Spirally coiled fine striations	9.1
37765	24.1	24.4	5.4	Very pale orange 10YR 8/2	Discoidal	Occasional	Spirally coiled	9.2
37766	22.0	19.3	2.6	Very pale orange 10YR 8/2	Discoidal	Rare	Spirally coiled many fine striations	9.3
37767	30.0	19.4	6.1	Grayish orange 10YR 7/4	Ovoid	Not Visible	Faint spiral striations	9,4
37768	42.9	26.7	17.6	Very pale orange 10YR 8/2	Ovoid	Not Visible	Scroll-shaped	9.5
37769	33.0	18.9	6.0	Very pale orange 10YR 8/2	Ovoid	Rare	Scroll-shaped	9.6
37770	36.4	23.9	8.2	Grayish orange 10YR 7/4	Oblong	Abundant	Many fine striations	9.7
37771	27.9	24.6	5.8	White N9	Oblong	Occasional	Spiral thick folds	9.8
37772	45.7	27.4	15.1	Grayish orange 10YR 7/4	Oblong	Rare	Vaguely scroll-shaped	9.9
37773	25.7	21.2	6.5	Very pale orange 10YR 8/2	Elongated	Rare	Many fine striations, thick spiral folds	9.10
37774	24.6	10.3	1.9	Very pale orange 10YR 8/2	Elongated	Rare	No striations or folds, very smooth surface	9.11
37775	21.8	10.0	1.6	Very pale orange 10YR 8/2	Elongated	Occasional	No striations or folds	9.12
37776	25.4	20.6	7.4	Light brown 5YR 5/6	Spherical	Abundant	Occasional fine striations, thick spiral folds	9.13
37777	19.3	18.1	3.4	Grayish orange 10YR 7/4	Spherical	Not Visible	Faint spiral striations	9.14
37778	20.2	18.7	3.8	Very pale orange 10YR 8/2	Spherical	Abundant	Faint spiral folds	9.15
37779	29.1	25.1	5.8	Grayish orange 10YR 7/4	Folded	Rare	Thick folds, many fine striations, rolled-up	9.16
37780	24.1	20.7	4.7	Pale yellowish brown 10YR 6/2	Folded	Not Visible	Thick folds, rolled-up	9.17
37781	23.2	21.8	6.3	Grayish orange 10YR 7/4	Folded	Not Visible	Vague thick folds, rolled-up	9.18
37782	30.3	20.2	7.3	Very pale orange 10YR 8/2	Amorphous	Abundant	Many fine striations, twisted folds	9.19
37783	43.4	37.0	12.7	White N9	Amorphous	Not Visible	No folds or striations, very smooth surface	9.29
37784	28.2	23.3	5.6	Very pale orange 10YR 8/2	Amorphous	Occasional	No folds or striations	9.21

TABLE 1. Continued.

NMMNH SPECIMEN NUMBER	LENGTH	WIDTH	WEIGHT	COLOR	MORPHOTYPE	INCLUSIONS	REMARKS	FIGURE
37837	28.5	26.3	4.73	Grayish orange 10YR 7/4	Discoidal	Occasional	Occasional fine striations	N/A
37838	27.4	26.3	4.75	Dark yellowish orange 10YR 6/6	Discoidal	Rare	Many fine striations	N/A
37839	17.7	17.5	2.03	Grayish orange 10YR 7/4	Discoidal	Not visible	Thick spiral concentric folds	N/A
37840	21.2	18.9	2.26	Grayish orange 10YR 7/4	Discoidal	Not visible	Fine striations, thick folds	N/A
37841	16.7	15.4	1.22	Grayish orange 10YR 7/4	Discoidal	Rare	Many fine striations	N/A
37842	18.0	17.0	1.76	Very pale orange 10YR 8/2	Discoidal	Rare	Faint fine striations	N/A
37843	18.2	16.8	1.53	Very pale orange 10YR 8/2	Discoidal	Rare	Faint fine striations	N/A
37844	30.6	17.5	5.02	Very pale orange 10YR 8/2	Ovoid	Rare	Faint striations	N/A
37845	33.3	17.6	6.58	Grayish orange 10YR 7/4	Ovoid	Abundant	No striations	N/A
37846	27.5	18.8	6.16	Dark yellowish orange 10YR 6/6	Ovoid	Occasional	No striations	N/A
37847	32.1	16.8	5.09	Grayish orange 10YR 7/4	Ovoid	Occasional	Fine striations	N/A
37848	32.1	21.2	5.85	Grayish orange 10YR 7/4	Oblong	Occasional	Rare striations	N/A
37849	21.3	18.2	1.97	Very pale orange 10YR 8/2	Oblong	Occasional	Faint striations	N/A
37850	30.6	22.6	4.86	Grayish orange 10YR 7/4	Oblong	Not visible	Many striations, thick folds	N/A
37851	26.8	19.6	5.50.	Pale yellowish brown 10YR 6/2	Oblong	Rare	Many striations	N/A
37852	21.6	21.2	4.24	Grayish orange 10YR 7/4	Spherical	Not visible	Many striations	N/A
37853	18.7	16.8	3.02	Pale yellowish brown 10YR 6/2	Spherical	Rare	Few striations	N/A
37854	16.2	15.7	2.19	Grayish orange 10YR 7/4	Spherical	Rare	Faint striations	N/A
37855	24.5	15.7	5.10	Very pale orange 10YR 8/2	Elongated	Rare	No striations	N/A
37856	25.2	11.6	1.66	Grayish orange 10YR 7/4	Elongated	Not visible	Rare striations	N/A
37857	28.6	11.7	2.02	Grayish orange 10YR 7/4	Elongated	Not visible	Rare striations	N/A
37858	19.8	6.6	0.65	Very pale orange 10YR 8/2	Elongated	Not visible	Occasional longitudinal striations	N/A
37859	18.9	18.6	2.62	Moderate yellowish brown 10YR 5/4	Folded	Occasional	Many striations	N/A
37860	16.9	16.8	1.91	Dark yellowish orange 10YR 6/6	Folded	Rare	Many convoluted striations	N/A
37861	23.2	18.7	2.50	Very pale orange 10YR 8/2	Folded	Not visible	Many transverse striations	N/A
37862	24.9	21.1	5.00	Pale yellowish brown 10YR 6/2	Folded	Not visible	Thick folds	N/A
37863	28.4	26.1	5.66	Grayish orange 10YR 7/4	Amorphous	Rare	Thin striations	N/A
37864	30.3	22.1	3.72	Grayish orange 10YR 7/4	Amorphous	Abundant	No striations	N/A
37865	29.1	23.6	5.80	Light brown 5YR 5/6	Amorphous	Not visible	Rare striations	N/A

spiral or scroll-shape morphology. Even though carcharhiniform skeletal remains have not been identified at the locality, and therefore the scroll-shaped coprolites cannot be attributed to any member of this order with certainty, these coprolites are still attributable to sharks and/or other fishes. The exact nature of the spiral valve in some of these groups is still in need of further study. The coprolites that do not exhibit a spiral or scroll-shaped morphology, may have suffered some degree of weathering or are attributable to teleost fishes, which do not posses spiral valves in their intestinal tract.

2. Coprolites are valuable indicators of the paleodiet of extinct organisms and most importantly they provide additional information in reconstructing ecosystem relationships of fossil flora and fauna of a given space and time. During Cenomanian times cretoxyrhinid sharks were top predators and this correlates well with the large number of Cretoxyrhina teeth collected at the locality. The anacoracid Squalicorax is known to have been a scavenger and a large number of teeth of this taxon were also found at the locality.

3. The excellent preservation of the coprolites is attributed to their initial viscosity and semi-solid form as they were deposited, the lack of coprophagic organisms, and their deposition in a low-energy, dysoxic/anoxic environment where practically no bacterial decay took place.

4. The anomalous concentration of coprolites in some environments is suggestive of certain set of sedimentological and environmental conditions. Poorly-oxygenated conditions prevailed during the entire Eagle Ford Group deposition. This is indicated by a marked high ratio of pelagic to rare benthic organisms, as well as a general absence of infauna. Possible drastic changes in the water column temperature and eustatic sea-level fluctuations took place during Eagle Ford time. The microfaunal assemblage exhibits an abundance of planktic forams , but the diversity of the population is very low. No benthic forams were found. This is also an indication of environmental stress at the locality. The environment of deposition of the new locality is interpreted as shallow marine, low-energy, offshore, thinly laminated and poorly oxygenated. This stressed environmental scenario is consistent with the Oceanic Anoxic Event recorded during the late Cenomanian worldwide.

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