BROMALITES FROM THE TINAJAS LAGERSTÄTTE (LATE PENNSYLVANIAN: LATE MISSOURIAN), CENTRAL NEW MEXICO, USA

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Abstract—The Tinajas Lagerstätte is located in the Cerros de Amado, Socorro County, New Mexico, USA. The strata at the locality are in the Upper Pennsylvanian Tinajas Member of the Atrasado Formation, which is of late Missourian age based on conodont biostratigraphy. The diverse bromalites (11 coprolites, 1 regurgitalite) from this Lagerstätte include 7 morphotypes (morphotype A – amphipolar, morphotype B – rounded cylinders, morphotype C – longitudinally-striated, morphotype D – small flattened ovoids, morphotype E – spindle shaped, morphotype F – ovoid with nodular texture, morphotype G – flattened ovoid with acanthodian scales), one existing ichnotaxon (*Conchobromus kinneyensis*) and 5 new ichnotaxa (*Crassocoprus mcallesteri*, *Spierocoprus socorroensis*, *Elongatocoprus amadoensis*, *Elacacoprus williamsi*, *Crustacoprus tinajaensis*).

INTRODUCTION

Upper Pennsylvanian strata in central New Mexico comprise interbedded marine and nonmarine sediments deposited in basins of the ancestral Rocky Mountain orogeny and contain several significant fossil localities (Zidek, 1992; Lucas and Ziegler, 2004; Lerner et al., 2009). The Kinney Brick Quarry Konservat Lagerstätte, in the Manzanita Mountains of Bernalillo County, preserves a diverse body-fossil fauna (invertebrate and vertebrate) and flora and vertebrate bromalites (Zidek, 1992; Hunt, 1992; Lucas et al., 2011). Lerner et al. (2009) provided a preliminary description of the newly-discovered Tinajas Lagerstätte in the Cerros de Amado of Socorro County, including some coprolites (ovoid and spiral). Spielmann et al. (2011) recognized at least six morphotypes of coprolites based on initial samples. Parties from the New Mexico Museum of Natural History and Science have subsequently collected additional samples of bromalites. The purpose of this paper is to provide a preliminary description of the diverse bromalites from this Lagerstätte, which we assign to 7 morphotypes, one existing ichnotaxon and 5 new ichnotaxa.

The bromalites from the Tinajas Lagerstätte include both coprolites and regurgitalites (*sensu* Hunt, 1992; Hunt and Lucas, 2012a). Regurgitalites are relatively uncommon and are distinguished from coprolites by a number of features including: (1) scarcity of groundmass; (2) larger size of inclusions; and (3) rare articulation of skeletal elements (Sanz et al., 2001; Myhrvold, 2011; Hunt and Lucas, 2012a; Vallon, 2012).

In this article, NMMNH refers to the New Mexico Museum of Natural History and Science, Albuquerque; and USNM refers to the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

GEOLOGIC SETTING

The strata at the Tinajas locality are in the Upper Pennsylvanian Tinajas Member of the Atrasado Formation (Lerner et al., 2009; Lucas et al., 2009). The Tinajas Member is of late Missourian age based on conodont biostratigraphy (Lucas et al., 2009). At the principal locality (NMMNH locality 4667), the lower 5.6 m of the exposed Tinajas Member are composed primarily of siltstone to fine-grained sandstone with intercalated thin shale intervals (Fig. 1: Lerner et al., 2009). The siltstone interval is overlain by a 5.2- to 7-m-thick black shale bed with a few small carbonate concretions that yields the vertebrate bromalites and fish specimens (Lerner et al., 2009). The black shale contains abundant conchostracans throughout and is interpreted to have been deposited in a poorly oxygenated lacustrine environment with fresh-to-brackish water and generally slow, gentle deposition (Lerner et al., 2009).

BROMALITES

Morphotype A

Morphology: Amphipolar.

Classification: Coprolite.

Referred specimen: NMMNH P-63817 (Fig. 2A).

Description: This coprolite is an elongate ovoid with an amphipolar-like structure, however, the spirals do not extend the full length. The coprolite is partially covered by matrix and is 12 mm long and 52 mm in maximum width. It consists of fine-grained phosphatic groundmass with no obvious inclusions.

Discussion: This morphotype is represented by a single specimen. The specimen is partly covered by matrix, so it could represent a poorly preserved heteropolar form. Based on spiral morphology it is likely that this coprolite was produced by less derived fish (e.g., Williams, 1972; Jain, 1983; McAllister, 1985; Hunt and Lucas, 2012b) such as small sharks, such as at Tinajas by xenacanths or sarcopterygians represented by *Greiserolepis*/*Megalichthyes* or cf. *Strepsodus* (Lerner et al., 2009).

Morphotype B

Morphology: Rounded cylinders.

Classification: Coprolite.

Referred specimens: NMMNH P-37670 (Fig. 2C), NMMNH P-37671, NMMNH P-37672 (Fig. 2B), NMMNH P-51226, NMMNH P-63780, NMMNH P-63781, NMMNH P-63784 (Fig. 2D), NMMNH P-63787, NMMNH P-63788, NMMNH P-63790, NMMNH P-63793, NMMNH P-63795, NMMNH P-63796, NMMNH P-63797, NMMNH P-63802, NMMNH P-63803, NMMNH P-63805, NMMNH P-63810, NMMNH P-63811, NMMNH P-63818, NMMNH P-63819.

Description: These coprolites are cylindrical and subrounded in cross section and a typically sized specimen is 33 mm long and 17 mm wide (NMMNH P-63784; Fig. 2D). They have rounded ends and contain abundant groundmass and no inclusions.

Discussion: Morphotype B is the most common bromalite morphotype at Tinajas. Palaeonisciform skeletal elements are the most abundant fish remains in the Tinajas locality assemblage and include

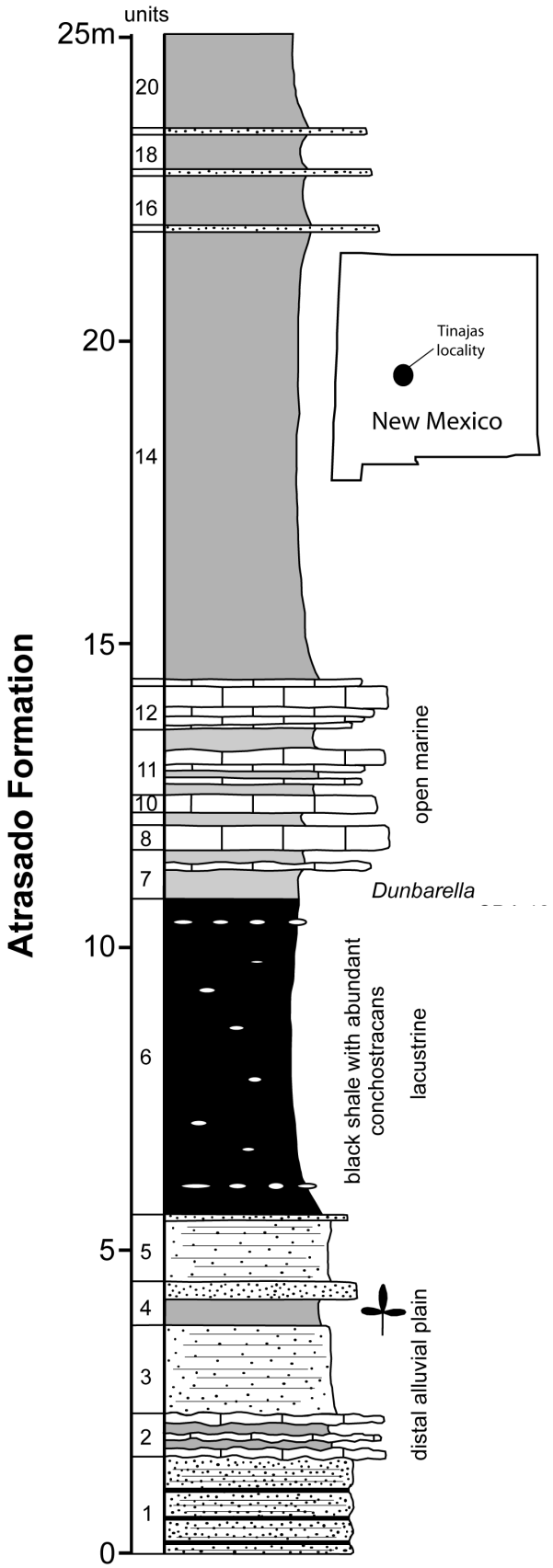

FIGURE 1. Stratigraphic section of part of Pennsylvanian Tinajas Member of Atrasado Formation at Tinajas Lagerstätte (after Lerner et al., 2009). The bromalites derive from NMMNH locality 4667, in unit 6.

disarticulated scales and bones belonging to Elonichthyidae, Haplolepidae and cf. Platysomidae (Lerner et al., 2009, figs. 7H, 8H-I). Given the abundance of this type of coprolite and the lack of a spiral structure, it is likely that morphotype B pertains to a palaeonisciform.

Morphotype C

Morphology: Longitudinally striated ovoid.
Classification: Coprolite.
Referred specimen: NMMNH P-63801 (Fig. 3A).
Description: NMMNH P-63801 is 31 mm long, 18 mm in diameter and rounded in cross section. The coprolite is cylindrical with rounded ends. There are prominent but shallow longitudinal striations on all sides that are about 0.75 mm in width. There are no inclusions, and the coprolite consists of phosphatic groundmass.
Discussion: The striations on this coprolite are less pronounced than in *Alococoprus* spp. and, it is relatively shorter and wider (compare Hunt et al., 2007, fig. 3 and Fig. 3A). Most specimens of *Alococoprus* spp. have rounded ends similar to morphotype C, although several of the specimens illustrated by Hunt et al. (2007, fig. 3A-B, E) have tapering or acute tips. The lack of a spiral structure suggests possible attribution to an acanthodian or a palaeonisciform.

Morphotype D

Morphology: Small flattened ovoid.
Classification: Coprolite.
Referred specimens: NMMNH P-37666, NMMNH P-37669 (Fig. 3B), NMMNH P-37671, NMMNH P-40185, NMMNH P-42201, NMMNH P-63779, NMMNH P-63794, NMMNH P-63798, NMMNH P-63804, NMMNH P-63809.
Description: Generally less than 10 mm long – 8 mm long and 5 mm wide (NMMNH P-37671). Some specimens are compressed (NMNNH P-40185), but most are more rounded (NMMNH P-37669: Fig. 3B). The relative amount of phosphatic groundmass and inclusions is variable.
Discussion: These coprolites are somewhat variable in morphology. Fish preserved at Tinajas that could produce a non-spiral coprolite would include acanthodians or palaeonisciforms (Lerner et al., 2009).

Morphotype E

Morphology: Spindle-shaped.
Classification: Coprolite.
Referred specimen: NMMNH P-40184 (Fig. 4A), NMMNH P-51223 (Fig. 4B).
Description: These specimens are medium sized, asymmetrically spindle shaped and exhibit poorly developed spirals. NMMNH P-40184 (Fig. 4A) is 27 mm long and 8 mm wide. One end of the coprolite tapers to an acute tip, and the other is rounded. NMMNH P-51223 (Fig. 4B) is 19 mm long with a maximum width of 7 mm. It has rounded ends and poorly developed spirals. The specimens consist principally of phosphatic groundmass with few inclusions.
Discussion: Neither of these specimens are well preserved but they appear distinct. Spiral structure indicates probable attribution to less derived fish such as chondrichthyans or sarcopterygians (e.g., Williams, 1972; Hunt and Lucas, 2012b).

Morphotype F

Morphology: Ovoid with nodular texture.
Classification: Coprolite.
Referred specimens: NMMNH P-51227, NMMNH P-63706, NMMNH P-63779, NMMNH P-63786, NMMNH P-63792 (Fig. 4C), NMMNH P-63808, NMMNH P-63817.
Description: These coprolites are ovoid to round in lateral view, generally flattened, and have irregular surfaces that suggest a composition of small rounded constituents. NMMNH P-63792 (Fig. 4C) is 20

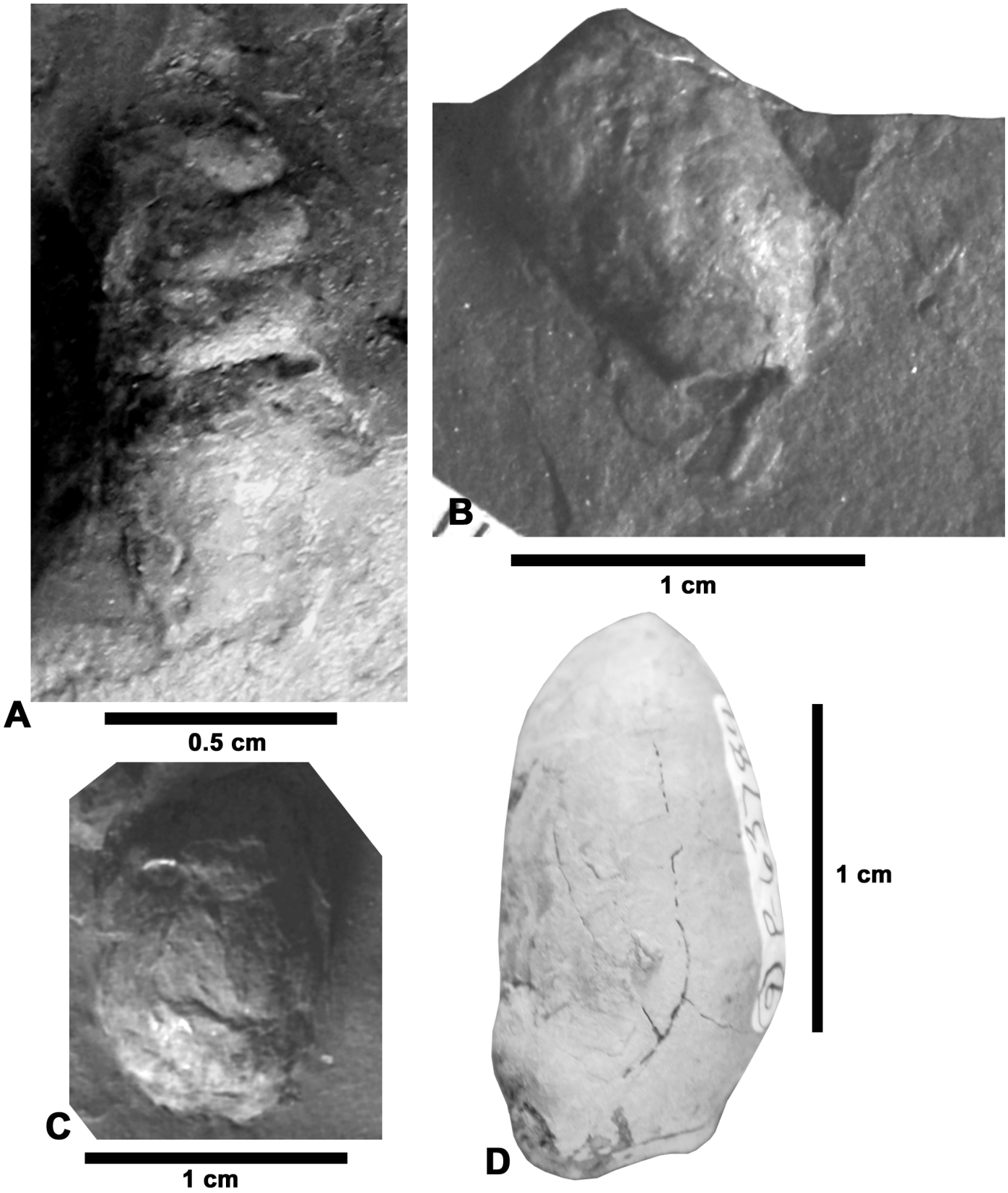

FIGURE 2. Coprolites from the Tinajas Lagerstätte in lateral view. **A**, Morphotype A, NMMNH P-63817, amphipolar coprolite. **B-D**, Morphotype B, rounded cylindrical coprolites, **B**, NMMNH P-37672, **C**, NMMNH P-37670 and **D**, NMMNH P-63784.

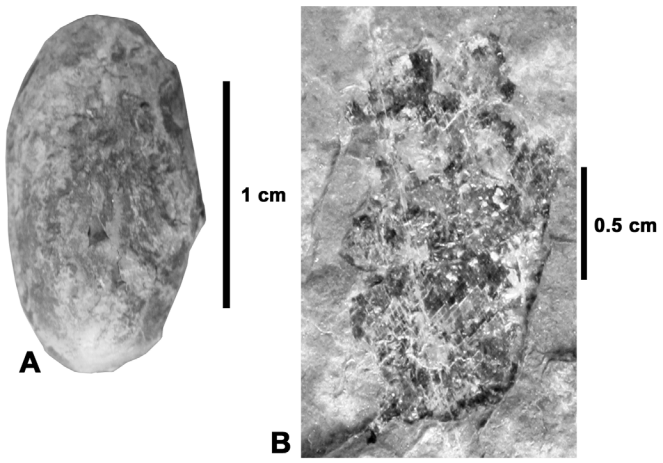

FIGURE 3. Coprolites from the Tinajas Lagerstätte in lateral view. **A**, Morphotype C, NMMNH P-63801, longitudinally striated coprolite. **B**, Morphotype D, small flattened ovoid coprolite.

mm long and 11 mm wide. Some specimens are smaller – NMMNH P-51227 is 5 mm wide and 7 mm long and NMMNH P-63706 is 8 mm long and 5 mm wide.

Discussion: The distinctive nodular surface texture implies that the coprolite is an aggregate of smaller rounded components. The relative abundance of these coprolites suggests that they may have been produced by the palaeonisciforms that are common at Tinajas (Lerner et al., 2009).

Morphotype G

Morphology: Flattened ovoid with acanthodian scales.

Classification: Regurgitalite(?).

Referred specimen: NMMNH P-37676 (Fig. 4D).

Description: NMMNH P-37676 is a flattened ovoid composed principally of acanthodian scales with limited groundmass. It has a length of 11 mm and a width of 8 mm.

Discussion: This partial bromalite is only represented by one specimen but it appears to be distinctive from the other morphotypes. The lack of groundmass may indicate that this is a regurgitalite (e.g., Vallon, 2012) and if so, it could have been produced by any of the fish at Tinajas, including an acanthodian.

Acanthodian fish remains are relatively scarce in the Tinajas fish assemblage (Lerner et al., 2009, fig. 8E). This may be a taphonomic artifact as opposed to reflecting their actual abundance as acanthodians tend to be poorly fossilized due to a weakly ossified internal skeleton (Lerner et al., 2009).

Unassigned morphotype

Referred specimens: NMMNH P-40202, NMMNH P-63782.

Classification: Coprolite.

Discussion: A few coprolites cannot be assigned to any of the described morphotypes or ichnotaxa.

Conchobromus kinneyensis Hunt et al., 2012

Referred specimens: NMMNH P-37667, NMMNH P-37668, NMMNH P-37673 (Fig. 4F), NMMNH P-37675 (Fig. 4E).

Description: There are four specimens that contain multiple valves of the conchostracan *Lioestheria carinacurvata* (Martens and Lucas, 2005) and little or no groundmass and are preserved as thin films on bedding planes. The largest and most complete specimen is NMMNH P-37675, which is 21 mm in length and 10 mm in width (Fig. 4E). The other three specimens are preserved on the edge of sheets of shale and they are incomplete. NMMNH P-37668 has preserved dimensions of 7 by 11 mm, whereas NMMNH P-37673 is 6.2 mm by 4 mm and NMMNH P-37667 is 8 mm by 5 mm.

Discussion: These specimens are nearly identical to the holotype and referred specimens of *Conchobromus kinneyensis* (Hunt et al., 2012) and clearly are referable to that ichnospecies. These specimens contain relatively little groundmass and probably represent regurgitalites (Hunt et al., 2012).

Crassocoprus, ichnogen. nov.

Type ichnospecies: *Crassocoprus mcallisteri* Hunt et al., 2012.

Included ichnospecies: Known only from the type ichnospecies.

Etymology: From the Latin *crassus* (thick), in allusion to the broad shaft of the bromalite, and the Greek kopros (dung).

Distribution: Late Paleozoic of United States and Early Tertiary of Europe.

Diagnosis: Heteropolar macrospiral (*sensu* Hunt et al., 2007) coprolite that differs from others in consisting of approximately 10 tight, irregularly-spaced coils that constitute 75% of the length (posterior spire of Hunt and Lucas, 2012b) of the coprolite and include irregular striations parallel to the long axis.

Discussion: This spiral coprolite probably pertains to a large chondrichthyan such as the xenacanth *Orthacanthus*, which is known from Tinajas (Lerner et al., 2009).

Diedrich and Felker (2012) described diverse spiral coprolites from the Eocene of central Europe. They recognize five morphotypes (A-E) of which four are narrowly defined. One (morphotype B) includes a variety of heteropolar macrospiral coprolites that Diedrich and Felker (2012) interpret to represent ontogenetic variants. Some of these specimens are of very similar morphology to the holotype of *Crassocoprus*, although more rounded in cross section (e.g., Diedrich and Felker, 2012, fig. 4.17). Thus, *Crassocoprus* is present in the Eocene of Europe. Other specimens of Diedrich and Felker's (2012) morphotype B could represent growth variants, while some appear to represent distinct morphotypes (e.g., Diedrich and Felker, 2012, fig. 4.22).

Crassocoprus mcallisteri, ichnosp. nov.

Holotype: NMMNH P-63717, coprolite (Fig. 5A-F).

Etymology: In recognition of James McAllister for his diverse contributions to the study of Paleozoic coprolites.

Type locality: Tinajas Lagerstätte, Socorro County, New Mexico (NMMNH locality 8042).

Type horizon: Tinajas Member of the Atrasado Formation (Late Pennsylvanian: middle Missourian).

Distribution: As for ichnogenus.

Referred specimens: Known only from the holotype.

Diagnosis: As for ichnogenus.

Description: NMMNH P-63717 is a large, 59-mm long, heteropolar macrospiral (*sensu* Hunt et al., 2007) coprolite (Fig. 5A-F). It has an ovoid cross section with a width of 22 mm and a maximum depth (at the end of the tightly coiled segment) of 19.3 mm. There are approximately 10 tight coils that extend for 75% of the length of the coprolite. Irregular striations that parallel the long axis are present on the tight coils. The coprolite includes abundant groundmass and some fish debris.

Discussion: This ichnotaxon is only known from one specimen, and, similarly, the large chondrichthyan *Orthacanthus* is only represented at the Tinajas locality by a single tooth (Lerner et al., 2009).

Speiracoprus, ichnogen. nov.

Type ichnospecies: *Speiracoprus socorroensis* Hunt et al., 2012.

Included ichnospecies: Known only from the type ichnospecies.

Etymology: From the Greek *speira* (spiral), in reference to the spiral morphology and *kopros* (dung).

Distribution: Late Pennsylvanian of New Mexico.

Diagnosis: Heteropolar, macrospiral (*sensu* Hunt et al., 2007)

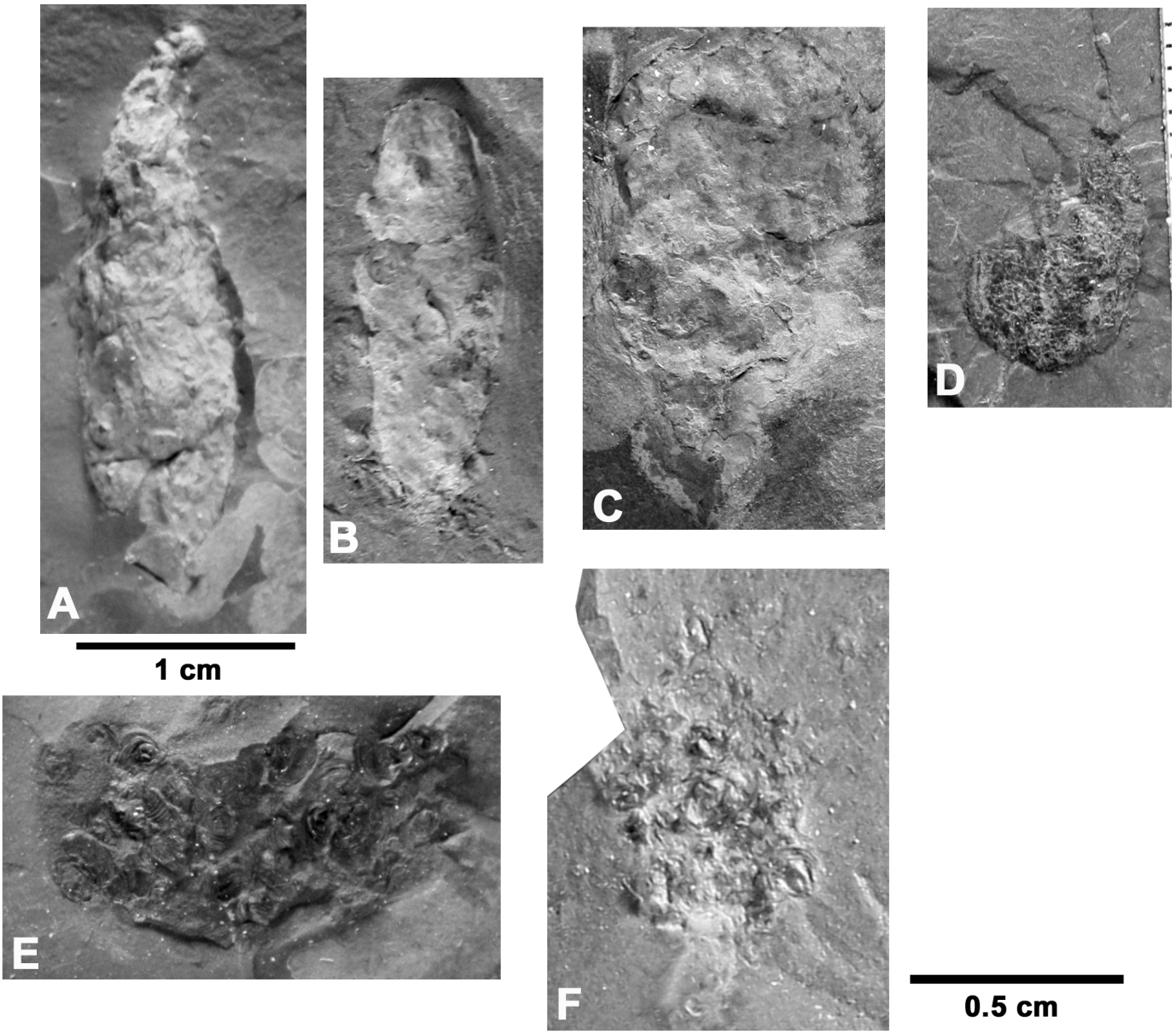

FIGURE 4. Coprolites and regurgitalites from the Tinajas Lagerstätte. **A-B**, Morphotype E, spindle shaped coprolites, **A**, NMMNH P-40184 and **B**, NMMNH P-51223. **C**, Morphotype F, ovoid coprolite with nodular texture, NMMNH P-63792. **D**, Morphotype G, flattened ovoid coprolite with acanthodian scales, NMMNH P-37676. **E-F**, *Conchobromus kinneyensis*, **E**, NMMNH P-37675, **F**, NMMNH P-37673. Upper left scale bar applies to **A-E** and lower right scale bar applies to **F**.

coprolite that differs from others in being proportionally short and wide with three coils with deep sulci between them, a narrow, acutely tipped posterior end and a rounded, conical anterior termination.

Discussion: Lerner et al. (2009, fig. 8D) attributed *Speirocoprus* to a xenacanthid shark such as *Orthacanthus*, which is represented at Tinajas by a tooth. However, this coprolite could have been produced by another chondrichthyan or a sarcopterygian.

Speiracoprus socorroensis, ichnosp. nov.

Holotype: NMMNH P-37674, coprolite part and counterpart (Fig. 5G; Lerner et al., 2009, fig. 8D).

Etymology: For the county of Socorro that yielded the holotype.

Type locality: Tinajas Lagerstätte, Socorro County, New Mexico (NMMNH locality 4667).

Type horizon: Tinajas Member of the Atrasado Formation (Late Pennsylvanian: middle Missourian).

Distribution: As for ichnogenus.

Referred specimens: Known only from the holotype.

Diagnosis: As for ichnogenus.

Description: The holotype NMMNH P-37674 is a heteropolar, macrospiral coprolite that is 16.7 mm long and 7.4 mm in maximum width (Fig. 5G). The coprolite is embedded in a sheet of matrix, and a natural mold is preserved on the counterpart. It is proportionally short and wide relative to other heteropolar ichnotaxa (e.g., *Heteropolacoprus*, *Liassocoprus*, *Saurocoprus*) of coprolites. There are three prominent coils. The posterior end is a rounded cone, whereas the anterior end is narrow and acute. It is composed of phosphatic groundmass with no inclusions.

Discussion: This distinctive coprolite is only known from one specimen.

Elongatocoprus, ichnogen. nov.

Type ichnospecies: *Elongatocoprus amadoensis* Hunt et al., 2012.

Included ichnospecies: Known only from the type ichnospecies.

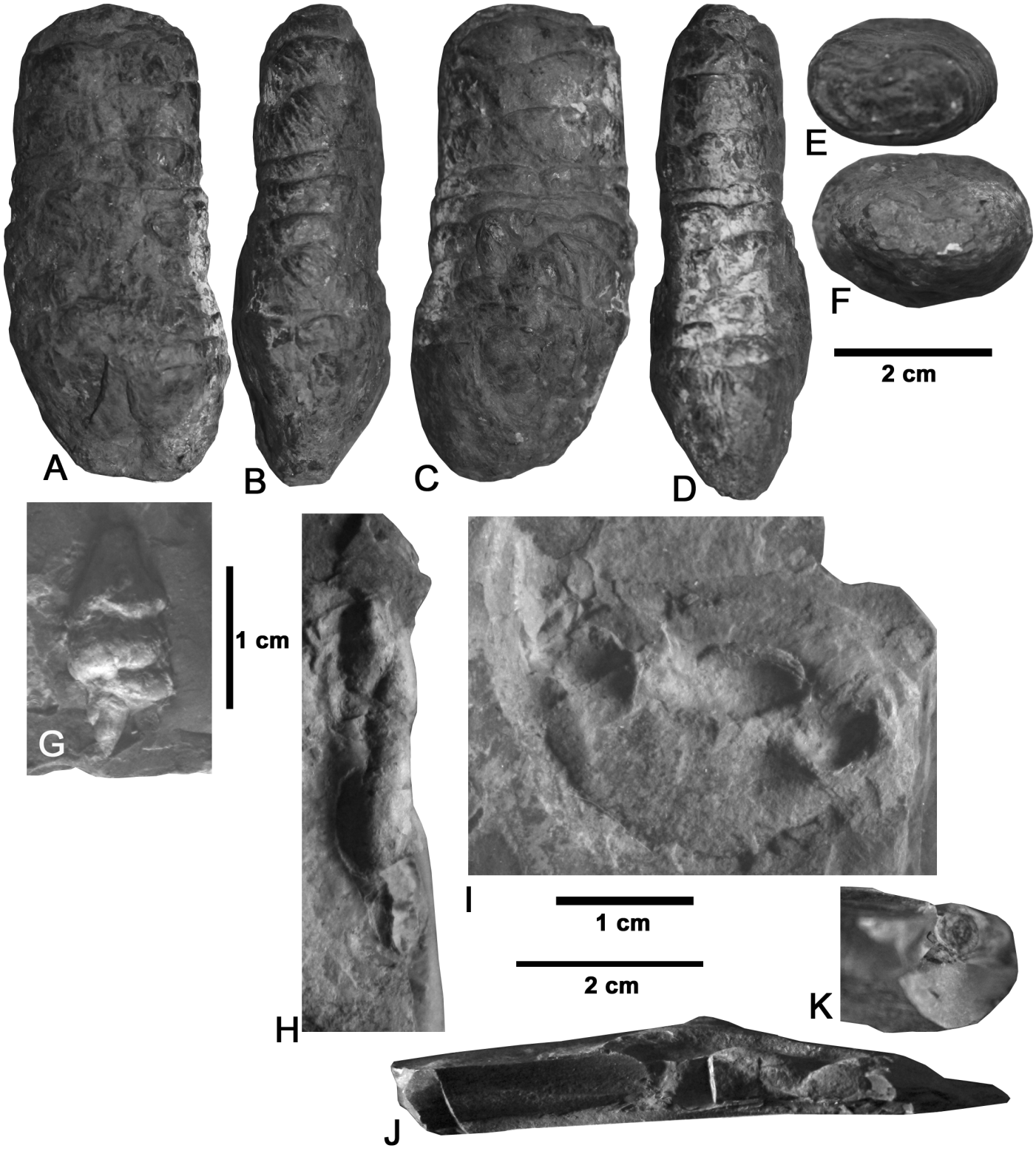

FIGURE 5. New ichnotaxa of coprolites from the Tinajas Lagerstätte. **A-F**, *Crassocoprus mcallisteri*, ichnogen et ichnosp. nov., NMMNH P-63717, coprolite in **A-D**, lateral, **E**, anterior and **F**, posterior views. **G**, *Speirocoprus socorroensis*, ichnogen et ichnosp. nov., NMMNH P-37674 in lateral view. **H-K**, *Elongatocoprus amadoensis*, ichnogen et ichnosp. nov., NMMNH P-40209, coprolite and natural mold of coprolite, **H**, coprolite in lateral view, **I**, natural mold, **J**, coprolite in lateral view, **K**, coprolite in cross section. Upper right scale bar applies to **A-F**, middle left scale bar applies to **G**, middle scale bar applies to **H-I**, and lower middle scale bar applies to **J-K**.

Etymology: From the Latin *elongatus* (long) in reference to the elongate shape, and *kopros* (dung).

Distribution: Late Pennsylvanian of New Mexico.

Diagnosis: Coprolite that differs from other ichnogenera in consisting of an elongate gently coiled cylinder with a round cross section that is tightly spiraled in cross section.

Discussion: The spiral structure of the coprolite suggests that it was produced by a chondrichthyan or sarcopterygian.

***Elongatocoprus amadoensis*, ichnosp. nov.**

Holotype: NMMNH P-40209, coprolite in matrix and natural mold (Fig. 5H-K).

Etymology: For Cerros de Amado which yielded the holotype.

Type locality: Tinajas Lagerstätte, Socorro County, New Mexico (NMMNH locality 4667) .

Type horizon: Tinajas Member of the Atrasado Formation (Late Pennsylvanian: middle Missourian).

Distribution: As for ichnogenus.

Referred specimens: Known only from the holotype.

Diagnosis: As for ichnogenus.

Description: NMMNH P-40209 is a narrow, rounded, elongate cylinder with a diameter of 6 mm and a length of 25 mm. In lateral view the coprolite is gently coiled (Fig. 5H, J), and in cross section it is tightly spiraled (Fig. 5K). The counterpart includes a natural mold (Fig. 5I). The coprolite consists of fine-grained phosphatic groundmass with no inclusions.

Discussion: This ichnospecies is only known from a single specimen. Because of its narrow, elongate morphology it is likely that specimens of *Elongatocoprus* that are free of matrix might have poor preservation potential.

***Elacacoprus*, ichnogen. nov.**

Type ichnospecies: *Elacacoprus williamsi* Hunt et al., 2012.

Included ichnospecies: Known only from the type ichnospecies.

Etymology: From the Greek *elakate* (spindle), in allusion to the characteristic spindle shape, and *kopros* (dung).

Distribution: Late Pennsylvanian of New Mexico.

Diagnosis: Elongated amphipolar coprolite that differs from other amphipolar ichnogenera (e.g., *Hyronocoprus*, *Kalocoprus*) in being narrow, elongate, and tapering posteriorly.

Discussion: The spiral morphology suggests that the coprolite was probably produced by a chondrichthyan or a sarcopterygian (e.g., Williams, 1972).

***Elacacoprus williamsi*, ichnosp. nov.**

Holotype: NMMNH P-63814, coprolite in matrix (Fig. 6A).

Etymology: For the late Michael Williams, to honor his work on spiral coprolites.

Type locality: Tinajas Lagerstätte, Socorro County, New Mexico (NMMNH locality 4667).

Type horizon: Tinajas Member of the Atrasado Formation (Late Pennsylvanian: middle Missourian).

Distribution: As for ichnogenus.

Referred specimens: NMMNH P-638785 (Fig. 6B).

Diagnosis: As for ichnogenus.

Description: The holotype, NMMNH P-63814, is a narrow, elongate, amphipolar coprolite that tapers posteriorly (Fig. 6A). It is 30.6 mm long with a maximum width of 3.6 mm and is preserved in matrix. It is composed of fine-grained phosphatic groundmass with no inclusions.

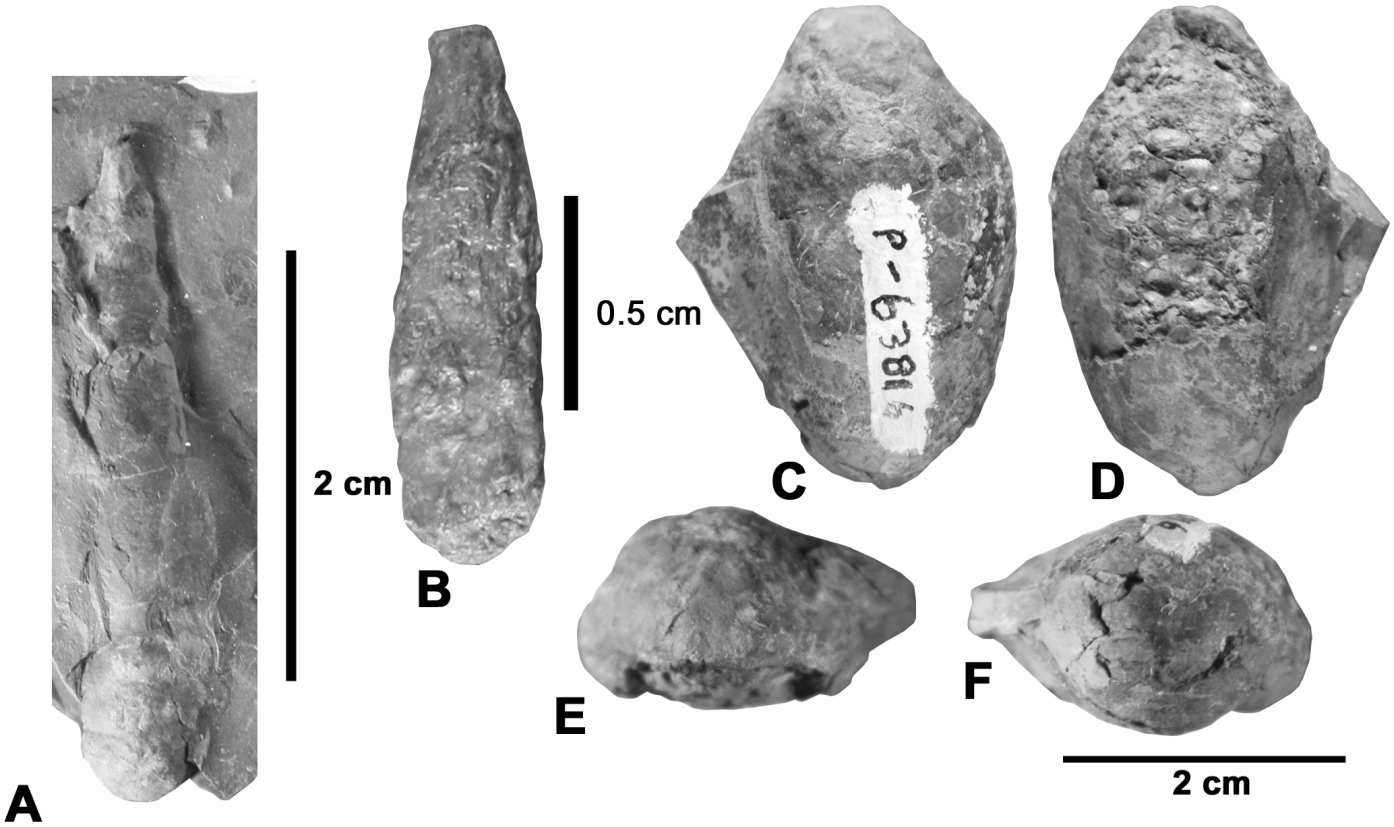

FIGURE 6. New ichnotaxa of coprolites from the Tinajas Lagerstätte. **A-B**, *Elacacoprus williamsi*, ichnogen et ichnosp. nov., **A**, NMMNH P-63814 and **B**, NMMNH P-63785, elongate coprolites in lateral view. **C-F**, *Crustacoprus tinajaensis*, ichnogen et ichnosp. nov., NMMNH P-63816, coprolite in **C-D**, axial and **E-F**, polar views.

Discussion: The referred specimen, NMMNH P-63785, is smaller than the holotype and is only 12.5 mm long and 3.6 mm wide (Fig. 6B). It is free of matrix.

Crustacoprus, ichnogen. nov.

Type ichnospecies: *Crustacoprus tinajaensis* Hunt et al., 2012.

Included ichnospecies: Known only from the type ichnospecies.

Etymology: From the Latin *crusta* (shell), in allusion to the characteristic valves of conchostracans, and *kopros* (dung).

Distribution: Late Pennsylvanian of New Mexico.

Diagnosis: Bromalite that differs from other ichnogenera except *Conchobromus kinneyensis* in being composed predominantly of conchostracan valves and is distinct from *Conchobromus* in that it contains abundant fine-grained phosphatic groundmass and is cylindrical in shape.

Discussion: The abundant groundmass indicates that *Crustacoprus* is a coprolite, whereas the lack of groundmass in *Conchobromus* may well indicate that it represents a regurgitalite. The candidates for producers of *Crustacoprus* would be the same as for *Conchobromus* – acanthodians or platysomids, both of which occur at Tinajas (Lerner et al., 2009).

Crustacoprus tinajaensis, ichnosp. nov.

Holotype: NMMNH P-63816, coprolite (Fig. 6C-F).

Etymology: For the Tinajas locality, which yielded the holotype.

Type locality: Tinajas Lagerstätte, Socorro County, New Mexico (NMMNH locality 4667) .

Type horizon: Tinajas Member of the Atrasado Formation (Late Pennsylvanian: middle Missourian).

Distribution: As for ichnogenus.

Referred specimens: Known only from the holotype.

Diagnosis: As for ichnogenus.

Description: NMMNH P-63816 is a large, ovoid coprolite, partially covered in matrix with a round cross section. It is 33.2 mm in length with a maximum diameter of 19 mm. It is composed of abundant conchostracan valves and a large amount of groundmass.

Discussion: Conchostracans are abundant in the black shale at the Tinajas locality. The valves are principally preserved flattened on bedding plane surfaces, which is typical of conchostracan preservation in other Carboniferous localities (Lerner et al., 2009). Martens and Lucas (2005) provided a detailed study of the Tinajas locality conchostracan assemblage and determined, based on characters of the larval shell, that the conchostracans there represented a new species, *Lioestheria carinacurvata*. *Lioestheria* is a cosmopolitan genus that ranges from the latest Carboniferous (Stephanian) to the Early (?Middle) Permian but *L. carinacurvata* is presently known only from the Tinajas locality (Martens and Lucas, 2005).

CONCLUSIONS

The Tinajas locality contains a relatively diverse ichthyofauna, including acanthodians (spines and bones of *Acanthodes*), a xenacanth (tooth of *Orthacanthus*), palaeonisciforms (scales and bones of Elonichthyidae, Haplolepidae and cf. Platysomidae) and sarcopterygians (scales, teeth, skull elements of *Greiserolepis* or *Megalichthyes* and cf. *Strepsodus*: Lerner et al., 2009). Possible attributions of the coprolites are: (1) conchostracan-bearing bromalites (*Crustacoprus tinajaensis*, *Conchobromus kinneyensis*) produced by acanthodians or platysomids; (2) spiral coprolites (morphotype A, morphotype E, *Crassocoprus mcallisteri*, *Speiracoprus socorroensis*, *Elongatocoprus amadoensis*, *Elacacoprus williamsi*) produced by chondrichthyans or sarcopterygians; and (3) non-spiral coprolites (morphotype B, morphotype C, morphotype D, morphotype F, morphotype G) produced by palaeonisciforms.

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