Vertebrate-Bitten Coprolite from South Carolina

By Stephen J. Godfrey and George Frandsen

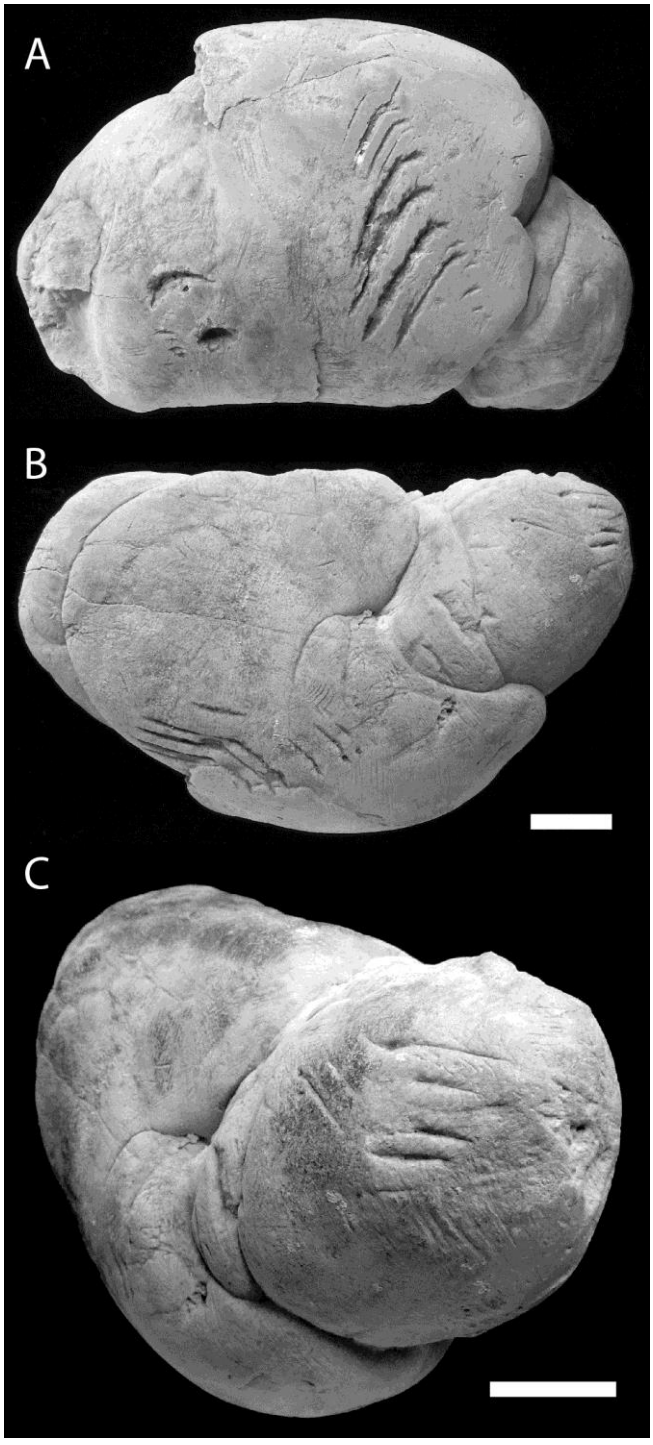

*Figure 1. CMM-V-*6615, *a vertebrate-bitten coprolite collected from a sand pit near Summerville, South Carolina. A-C. This vertebrate coprolite preserves three prominent series of tooth scorings over its surface. B. Coprolite turned about its long axis 180 degrees to show additional tooth markings on its reverse side. C. Coprolite turned approximately 60 degrees from its position in B. to illustrate the bite-marks on its small hemispherical end. Specimen whitened with sublimed ammonium chloride to improve contrast and highlight detail. White scale bars equal 10 mm.*

*Figure 2. CMM-V-*6615, *a vertebrate-bitten coprolite, natural color. The large black arrow points to a primary striation (tooth gouge), whereas the small white arrows point to secondary tooth gouges. Hand by M. Baughman. Photos by S. Godfrey.*

Introduction

Of all the coprolites known from the fossil record, only three have been formally recognized as preserving vertebrate tooth impressions or bite marks (Godfrey and Smith, 2010; Godfrey and Palmer, 2015). Here we describe another unique coprolite, *CMM-V-*6615 (Calvert Marine Museum Vertebrate collection), (Figs. 1 & 2), that preserves tooth bite and raking marks over its surface. We presume that the interaction between the toothy vertebrate and coprolite was exploratory: Was the coprolite edible? Evidently, it turned out not to be.

Geological Setting

The coprolite was found near Summerville, South Carolina. Summerville is situated mostly in Dorchester County with small portions in Berkeley and Charleston counties. The coprolite was acquired from an online vendor by G. F. and donated to the Calvert Marine Museum. Unfortunately, the vendor was unwilling to provide exact collecting locality information (other than to say that it was removed from a local sand pit), substantially diminishing the scientific value of this otherwise important specimen!

Sand pits in the Summerville area remove sand down to the top of the early Oligocene Givhans Ferry Member of the Ashley Formation (R. Weems pers com.). In so doing, Oligocene, Miocene, Pliocene, and Pleistocene fossils are also unearthed. Based on this information, the coprolite is no older than early Oligocene.

From the natural color of this coprolite, its origin from within the Ashley Formation has been suggested (J. Geisler pers com.). The Ashley Formation is now considered to be Rupelian (Early Oligocene) in age (Geisler and Sanders, 2006; Weems and Sanders, 2014; Weems et al., 2004).

The Oligocene paleoenvironment in the Summerville area was a nearshore coastal environment (Weems and Sanders, 2014).

Description

CMM-V-6615 approximates the shape of an oblate spheroid – 98 mm long and 60 mm in diameter at its maximum girth. It weighs 219.4 g. It is beige to dark brown in color (Fig. 2) and exhibits deep folds that wrap its circumference. Prominent tooth-raking marks occur on both sides of the coprolite (Fig. 1A and B and Fig. 2) as well as on its smallest hemispherical end (Fig. 1C). The tooth marks in the two series of primary bite marks (Fig. 1A & B and Fig. 2) are linear. However, the long axes of these two linear series of tooth marks on opposite sides of the coprolite are offset by about 45 degrees from each other (making it seem less likely that both series were made during one bite by upper and lower teeth respectively). Within these two linear series, tooth spacing is very nearly 5 mm throughout. In both of the linear series of bite marks, following the initial contact of teeth to coprolite, the teeth moved perpendicular to the tooth row, then they were raked away over the surface of the feces at an angle of about 45 degrees. The teeth penetrated into the coprolite to a maximum depth of about 1 mm.

The markings on the hemispherical end of the coprolite are approximately 2 mm apart but could represent tooth marks from successive passes (i.e., bites) over the surface.

Additionally, much of the surface of CMM-V-6615 is marked by many hundreds of finer parallel-sided striations of unknown origin.

Discussion

Although the identity of the animal that produced the coprolite remains unknown, it is consistent in its size and shape to those previously attributed to crocodilians (Hantzschel et al., 1968; Sawyer, 1981; Sawyer, 1998; Hunt and Lucas, 2010; Milàn, 2012).

The alignment of the bite marks indicates that the biter had nearly straight jaws; at least throughout the section represented by these bite marks. In this regard, they resemble the bite marks described in another coprolite from South Carolina (CMM-V-4480, Fig. 3) as having been made by a gar (Fig. 4, *Lepisosteus* sp; Lepisosteidae) (Godfrey and Palmer, 2015).

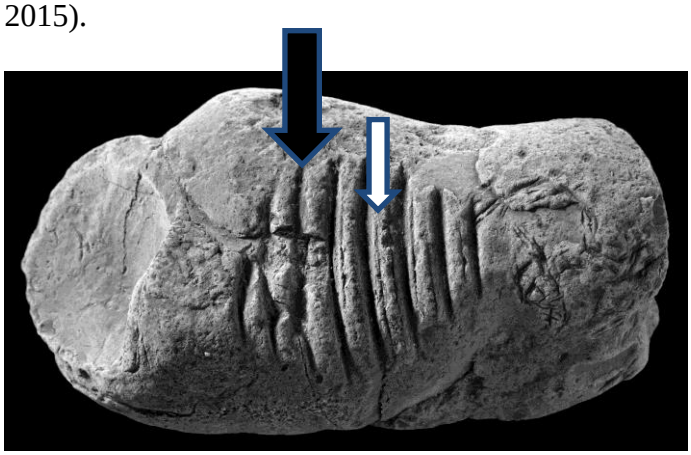

Figure 3. Gar tooth-marked coprolite (CMM-V-4480) showing the primary (large black arrow) and secondary (small white arrow) tooth striations. Specimen whitened with sublimed ammonium chloride to improve contrast. Modified from Godfrey and Palmer, 2015).

In Figure 2, the two white arrows mark several shallower tooth gouges that occur adjacent to and between the deeper primary ones, suggesting a

jaw with teeth like that of a gar; it possesses large medial fangs and smaller peripheral teeth (Fig. 4). However, because the finer gouges in CMM-V-6615 are not as uniform as are those described in CMM-V-4480 (Godfrey and Palmer, 2015; Fig. 3), we do not identify these bite marks as having been made by a gar. Furthermore, there do not appear to be any diagnostic features associated with these tooth marks that conclusively identify the taxon that bit CMM-V-6615!

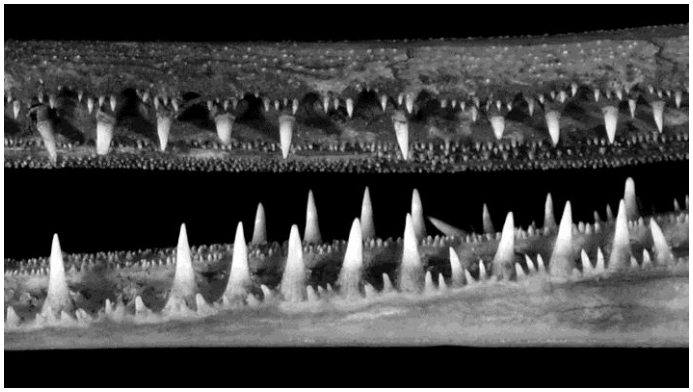

*Figure 4. Left lateral view of the mid-section of the rostrum of an extant gar (*Lepisosteus osseus, *CMM-O-33) showing the presence of many small peripheral teeth adjacent to the fewer larger fangs in both the upper and lower jaws. Modified from Godfrey and Palmer, 2015).*

The bold tooth gouges on CMM-V-6615 are also interesting because the edges of some of the markings (Figs 1A and 2) are "ragged", suggesting that the surface of the coprolite did not yield compliantly as the teeth raked its surface. The markings give the impression that the coprolite was firm enough at the time it was bitten to preclude tooth penetration to the full height of the tooth.

We don't know why the coprolite was originally bitten, other than to suggest that perhaps it was done to assess its palatability; some creatures engage in coprophagy. If that was why, evidently it was deemed unpalatable, whereby increasing the odds of it becoming fossilized.

Acknowledgments

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