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FIRST RECORD OF A CHIMAEROID FISH FROM THE EOCENE OF THE SOUTHEASTERN UNITED STATES

DENNIS PARMLEY[1] AND DAVID J. CICIMURRI[2]

[1]Department of Biological and Environmental Sciences, Georgia College and State University, Milledgeville 31061, <dennis.parmley@gcsu.edu>, and [2]Bob Campbell Geology Museum, Clemson University, Clemson, South Carolina 29634, <dcheech@clemson.edu>

INTRODUCTION

Although fossilized teeth of sharks and rays are common elements in Eocene nearshore marine sediments of the southeastern United States (Parmley and Cicimurri, 2003 and references within), fossil remains of chimaeroid fishes are unknown from this region. Here we provide the first report of an Eocene chimaeroid fish from the southeastern United States, consisting of a partial, well-preserved left mandibular tooth plate recovered from central Georgia.

The specimen was collected from late Eocene (ca. 36.0–34.2 Ma; Parmley and Holman, 2003) Clinchfield Formation sediments exposed in an abandoned central Georgia kaolin mine formally known as the Hardie Mine (Westgate, 2001). The Hardie Mine is located approximately 3.9 km north-northeast of Gordon, Wilkinson County, Georgia. This site has yielded a relatively well-preserved and diverse nearshore marine vertebrate fauna consisting of sharks, rays, bony fishes, reptiles, and whales (Westgate, 2001; Parmley and Cicimurri, 2003; Parmley and Holman, 2003). Additionally, the vertebra of a colubrid snake (Parmley and Holman, 2003) and partial teeth of at least two species of land mammals (unstudied fossils in the paleontological collections of Georgia College and State University–GCVP) are known from the Hardie Mine site. The vast majority of fossils collected from the Hardie Mine were recovered from a series of spoil pile sediments. It has been shown, however, that these sediments were derived locally from nearby in situ fossiliferous Clinchfield Formation sediments exposed in the north wall of the mine (see Westgate, 2001; Parmley and Cicimurri, 2003; Parmley and Holman, 2003).

SYSTEMATIC PALEONTOLOGY

For the purposes of this report we follow the descriptive terminology utilized by Stahl (1999), and a comprehensive classification scheme can be found in Stahl and Parris (2004). We utilized the histological terminology of Stahl (1999), but we did not perform any direct microscopic analyses of tissues. The specimen is part of the vertebrate paleontology collection of the South Carolina State Museum (SC) in Columbia.

Order Chimaeriformes Obruchev, 1953
Family Callorhynchidae Garman, 1901
Subfamily Edaphodontinae Stahl, 1999
Genus Edaphodon Buckland, 1838
Edaphodon sp.
Figures 1, 2

Description.—The specimen is a well-preserved but incomplete left mandibular tooth plate. The distal one third of the plate is missing, and the preserved mesodistal length measures 10.3 cm, with maximum labiolingual width measuring 26 mm. The plate is laterally compressed, with the mesial end elongated into a rather long beaklike structure. The left and right plates were articulated along a broad, flat symphyseal surface. This surface is 15 mm deep mesially, but tapers as it extends distally just below the oral surface to a distance of 68 mm. At the point immediately distal to the symphyseal surface, the plate begins to diverge labially. The labial face is convex and smooth dorsally and ventrally, but medially concave and striated parallel to the length of the plate, and there is no descending lamina. Whereas the ventral aspect of the lingual face is concave and bears a series of parallel ridges extending from the symphyseal surface to the distal break, the dorsal aspect is convex and bears the middle tritor.

There are four tritors: a symphyseal tritor exposed at the mesial tip extending 22 mm along the labial oral margin and 8 mm near the lingual margin (mostly covered by dentine), an ovoid anterior outer tritor, broken posterior outer tritor, and the much larger middle tritor (Fig. 1.3). The anterior outer tritor is situated on a prominence located labially and near the mesial one third of the middle tritor. The posterior outer tritor is largely incomplete but is located on a higher prominence on the labial margin, adjacent to the middle tritor. In labial view the oral margin of the labial face has a ‘‘stepped’’ appearance due to the prominences. The middle tritor constitutes the upper half of the lingual face distal to the symphyseal surface, and some of the tritoral tissue is covered by dentine. The outer and middle tritors are punctate due to the intersection of internal vascular canals with the occlusal surface. The majority of the tooth plate consists of trabecular dentine, whereas the tritors are associated with much denser, compact dentine.

Material examined.—SC 2004.34.1, incomplete left mandibular tooth plate.

Occurrence.—Late Eocene (ca. 36.0–34.2 Ma) Clinchfield Formation, Hardie Mine, approximately 3.9 km north-northeast of Gordon (32°54.335′N, 83°21.543′W latitude and longitude), Wilkinson County, Georgia.

Discussion.—SC 2004.34.1 shows no signs of abrasion, thus the lack of descending lamina (Stahl, 1999) allows us to exclude the plate from members of Callorhynchinae, such as *Ischyodus* Egerton, 1843 and *Callorhinchus* Lacépede, 1798. The overall morphology is consistent with *Edaphodon* because: 1) it is robust but tapered mesially into a long beak; 2) the symphyseal surface is wide mesially but narrows distally; and 3) there are four tritors (Fig. 1.3)–symphyseal, anterior outer, middle, and posterior outer. (Agassiz, 1843; Stahl, 1999; Stahl and Parris, 2004).

Remains of *Edaphodon* are well known from Cretaceous strata, but comparatively few taxa have been reported from Tertiary sediments (Buckland, 1838; Agassiz, 1843; Cope, 1869, 1875). Stahl (1999) recognized eight species in the United States, however only *E. eocaenus* (Cope, 1875) is known to occur outside of Cretaceous strata. Other species known from the Eocene of Europe include *E. bucklandi* Agassiz, 1843 and *E. leptognathus* Agassiz, 1843. A third species, *E. minor* Ward, 1973, may represent a juvenile form of *E. bucklandi* (Kemp et al., 1990).

Unfortunately, making a specific identification from a single specimen is difficult because of the degree of ontogenetic variation within the genus. For example, Woodward (1891) and Hussakof (1912) demonstrated that several species of *Edaphodon* erected by Cope (1869, 1875) actually represented various growth stages of *E. mirificus* Leidy, 1856. At the broken distal end of SC 2004.34.1, the hypermineralized tissue of all four tritors is visible

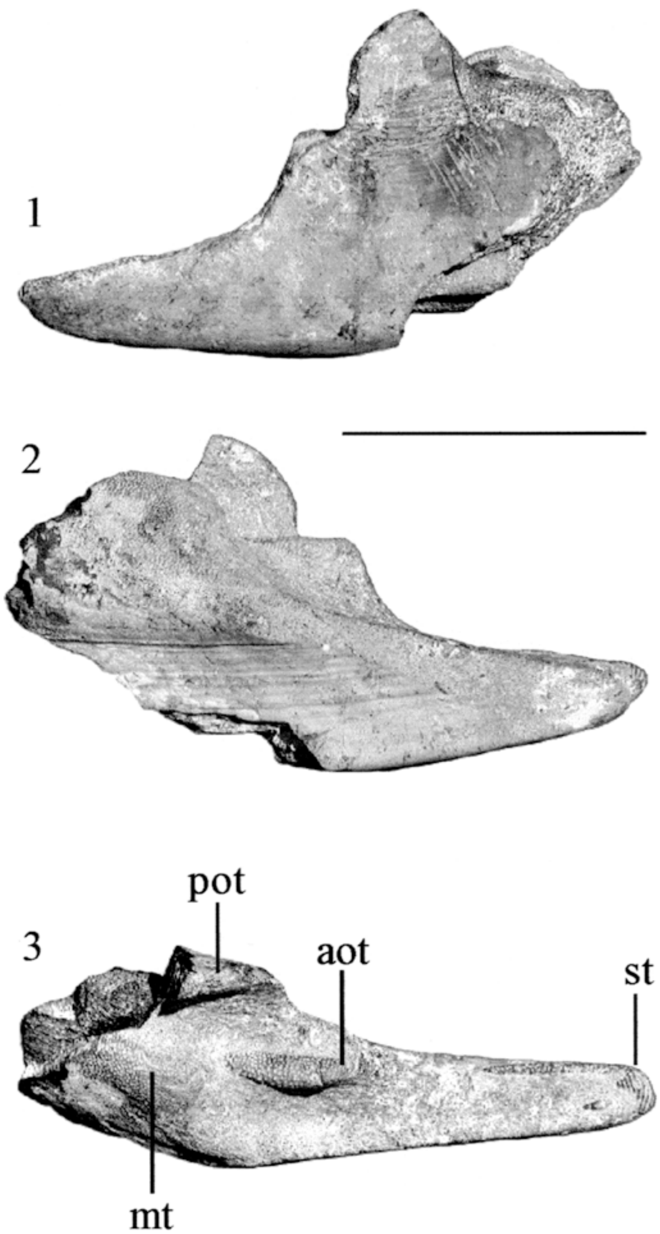

FIGURE *1*—*Edaphodon* sp., SC 2004.34.1, left mandibular tooth plate: *1,* labial view, mesial end left; *2,* lingual view, mesial end right; *3,* oral view, mesial end right. Abbreviations as follows: aot, anterior outer tritor; mt, middle tritor; pot, posterior outer tritor; st, symphyseal tritor. Scale = 5 cm.

in cross section, and their locations and morphology in this view indicate that overall plate shape can change drastically over time as it is worn (Fig. 2). Stahl and Parris (2004) have also shown that there can be intraspecific variation because the upper and lower tritors may not perfectly occlude, resulting in differential wear of the tooth plates of an individual fish.

Although it seems highly unlikely that the temporal range of Cretaceous forms would span 30 Ma into the late Eocene, we compared SC 2004.34.1 with *E. agassizi* (Buckland, 1838), *E. barbieri* Applegate, 1970, *E. mirificus*, and *E. sedgwicki* (Agassiz, 1843). These comparisons revealed conspicuous differences in overall size, beak shape, and location/morphology of the tritors

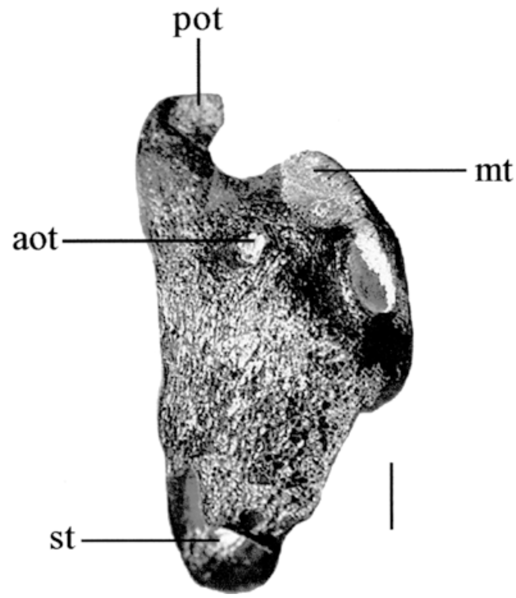

FIGURE *2*—Distal view of SC 2004.34.1, showing internal positions of tritoral tissue. Abbreviations as in Figure 1. Scale = 1 cm.

(Buckland, 1838; Agassiz, 1843; Applegate, 1970; Stahl and Parris, 2004). The same applies to *E. leptognathus*, where SC 2004.34.1 also has a wider symphyseal area, straighter lingual oral margin, and a less deep mesial sulcus of the middle tritor (Agassiz, 1843; Stahl, 1999). In addition, judging by the location of the tritoral tissue in distal cross section of SC 2004.34.1, the symphyseal tritor would not have extended along the ventral margin of the lingual face as it does in *E. leptognathus* (e.g., Kemp et al., 1990). SC 2004.34.1 is more similar to *E. bucklandi* in these respects, although the prominences of the anterior outer and posterior outer tritors are not as high (Agassiz, 1843; Kemp et al., 1990; Stahl, 1999). The type mandibular plate of *E. eocaenus* (AMNH 7205) is poorly preserved, but this specimen differs from SC 2004.34.1 in having a more uniformly convex labial surface and a more gradual transition from the beak to the anterior outer tritor (especially evident in labial view). Pending collection of additional material to determine the morphology of other elements such as the vomerine and palatine plates, as well as morphological variation within these elements, we hesitate to assign a specific identification to the Hardie Mine specimen.

CONCLUSIONS

Although we hesitate to make a specific identification, SC 2004.34.1 is referable to *Edaphodon* and appears to be most similar in overall morphology to *E. bucklandi*. The Hardie Mine specimen is significant because it represents the first documented fossil of a chimaeroid fish from Eocene deposits of the southeastern United States. The specimen may represent a young individual as indicated by the relatively unworn nature of the tritors (i.e., significant portions of the middle and symphyseal tritors are still covered by dentine).

The tritors of the tooth plate consist of pads of hypermineralized tissue that formed hard crushing surfaces. With the aid of the tritors, the Hardie Mine chimaeroid probably took advantage of a diverse invertebrate assemblage that included gastropods, pelecypods, crustaceans, and large solitary scleractinian corals (unreported fossils in the GCVP and Bob Campbell Geology Museum collections).

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