EKGMOWECHASHALA (MAMMALIA, ?PRIMATES) FROM THE GULF COASTAL PLAIN

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A single, small, water-worn tooth from the "middle" Arikareean Toledo Bend Local Fauna of the Gulf Coastal Plain closely resembles the lower fourth premolar of the questionable primate *Ekgmowechashala.* The only known species of the genus, *Ekgmowechashala philotau* Macdonald (1963), was originally recovered from the early Arikareean Sharps Formation of South Dakota, but is also known from similar aged strata of the John Day Formation, Oregon. Although the Toledo Bend specimen differs somewhat in morphology from the p4 of *E. philotau*, a new species is not named in this report because of such limited material and because the specimen is incomplete. Unfortunately, the specimen does not provide information that helps clarify current arguments regarding the affinities of *Ekgmowechashala* with primates or plagiomenids. It does, however, provide (1) a temporal range extension for the genus to the early late Arikareean, or about four million years younger than previously known, and (2) a geographic extension east and considerably south of its prior distribution. If *Ekgmowechashala* is ultimately determined to belong to the Primates, then the Toledo Bend species would become the last known North American representative of the order.

Key Words: *Ekgmowechashala*; Primates; Plagiomenidae; Texas Gulf Coastal Plain; Arikareean

INTRODUCTION

In 1990, while screen-washing matrix from the "middle" Arikareean Toledo Bend site in the Fleming Formation of easternmost Texas (Albright 1994, 1996, 1998a, 1998b, 1999), a small, unusual, water-worn tooth was recovered that differed considerably from the site's more common and readily identifiable rodent teeth. Recent reexamination of this tooth finds it most similar in size and morphology to the lower fourth premolar of the questionable primate or plagiomenid, *Ekgmowechashala philotau* Macdonald (1963), from the early Arikareean of South Dakota and Oregon. However, subtle differences suggest a possible second species. This paper does not attempt to resolve the somewhat controversial taxonomic status of *Ekgmowechashala* (discussed below), but is written to provide evidence of a possible new species of the genus in the Gulf Coastal Plain during what is likely a later interval of the Arikareean than records from South Dakota and Oregon (Fig. 1). The naming of a new species, however, should await recovery of additional material, as only the single tooth is currently known. The specimen is curated in the vertebrate paleontology collections of the Louisiana State University Museum of Geoscience (LSUMG V).

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BACKGROUND

Ekgmowechashala philotau is a small "enigmatic late Oligocene mammal" (McKenna, 1990:226) heretofore known only from the early Arikareean of Oregon and South Dakota, and considered by some (Macdonald 1963, 1970; Szalay 1976; Szalay & Delson 1979; Rose & Rensberger 1983) to be the last North American primate (excluding late Cenozoic immigrants from South America). Others, on the other hand (e.g., McKenna 1990), have argued that this taxon is a member of the Plagiomenidae, a solely North American group that some (e.g., Rose & Simons 1977) consider to be the only family of fossil mammals that can be referred to the extant Dermoptera (flying lemurs) of southeast Asia. However, MacPhee et al. (1989) concluded on the basis of basicranial characters that plagiomenids (based on *Plagiomene*) are not closely related to dermopterans (specifically, the extant dermopteran *Cynocephalus*). MacPhee et al. (1989) considered the dental resemblance between *Ekgmowechashala* and plagiomenids a likely result of convergence, and maintained the proposition that *Ekgmowechashala* was a "highly derived, late-surviving omomyid."

Figure 1. Locations from which *Ekgmowechashala* is known: John Day Valley, Oregon; Wounded Knee area, southwestern South Dakota; and Toledo Bend locality, Newton County, Texas.

Szalay (1976) erected the omomyid subfamily Ekgmowechashalinae for *Ekgmowechashala philotau* because of distinct differences it displayed relative to the Anaptomorphinae, Omomyinae, and Microchoerinae. These differences include an m1>m2>m3 size relationship, a large, molarized p4, reduction of the two incisors, and the lack of transverse tori on the mandibular symphysis. Although the upper dentition of *Ekgmowechashala* had not yet been described during the time of Szalay's analysis, he hypothesized that its ancestry was "very likely near the [omomyid] genus *Rooneyia*" (1976:355), but later added (in Szalay & Delson 1979:257) that "its closer affinities within the Omomyidae are impossible to ascertain as most of its features are quite unique." Later, when Rose and Rensberger (1983:109) described the upper dentition, they too noted the "possible derivation of *Ekgmowechashala* from a form close to *Rooneyia*" (the omomyine *Rooneyia viejaensis* was described by Wilson (1966) from the early Chadronian of west Texas).

Noting the doubts that previous workers had regarding the assignment of *Ekgmowechashala* to the Omomyidae because of its many differences and unique characters, McKenna (1990) transferred the Ekgmowechashalinae to the possibly dermopteran (Rose & Simons 1977) family Plagiomenidae. McKenna based this referral on what he considered to be shared similarities of both the upper and lower dentition between *Plagiomene, Planetetherium, Worlandia, Tarkadectes*, and *Tarka*, as well as *Ekgmowechashala*. He included *Tarka* and *Tarkadectes*, together with *Ekgmowechashala*, in the Ekgmowechashalinae, whereas *Plagiomene, Planetetherium,* and *Worlandia* comprised the Plagiomeninae.

More recently, Szalay and Lucas (1996:32) reviewed the dentition of the plagiomenids *Tarka* and

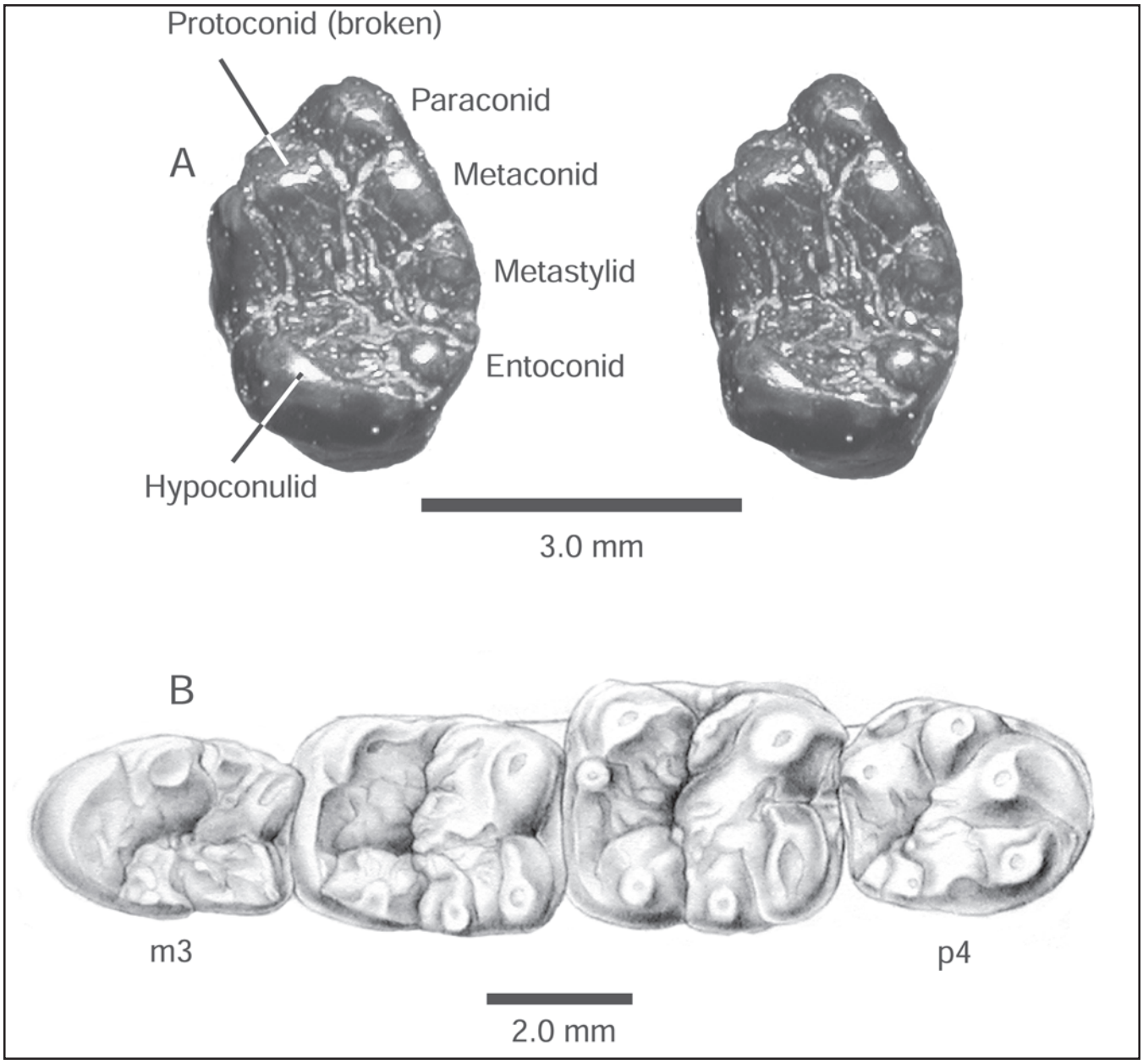

Figure 2. A. Stereo occlusal view of *Ekgmowechashala* sp. (LSUMG V-2766) from Toledo Bend locality, Texas. B, Artist reconstruction of lower dentition of *Ekgmowechashala philotau*, based on South Dakota specimens SDSM 5550 and SDSM 62104, and on Oregon specimen LACM 9207 (reproduced and modified from Szalay (1976:fig. 133) with permission from F. Szalay). SDSM, South Dakota School of Mines, Rapid City, South Dakota; LACM, Natural History Museum of Los Angeles County.

Tarkadectes, and of *Ekgmowechashala*, from a "functional-adaptive perspective." In conclusion, they reaffirmed the opinion that *Ekgmowechashala* was a "surviving Oligocene branch of the Omomyidae" not to be allied with the Plagiomenidae, and that the Ekgmowechashalinae should be maintained as an omomyid subfamily. Szalay and Lucas (1996) assigned *Tarkadectes* to their newly erected plagiomenid subfamily, Tarkadectinae.

The weight of evidence, therefore, still favors the referral of *Ekgmowechashala* to the primate family Omomyidae, despite the many differences most work-

ers cite. However, no other particularly diagnostic remains of *Ekgmowechashala* other than teeth, such as a skull with basicranium, have been identified that might shed further light on this matter. The issues, therefore, of whether *Ekgmowechashala* is a highly derived, late surviving omomyid primate or a plagiomenid, as well as whether the Plagiomenidae are dermopterans, currently remain unresolved.

DESCRIPTION

Referral of this isolated tooth (LSUMG V-2766; Fig. 2) to *Ekgmowechashala* is based on its low crown height and the "heavily etched … dendritic system of grooves" seen in the talonid basin (Szalay 1976:355). The tooth measures 3.8 mm anteroposteriorly by 2.8 mm transversely and appears to be a left p4 based on similarities with that tooth of *E. philotau*. These similarities include the following characteristics (cusp terminology follows Szalay 1976; McKenna 1990): anterolingual paraconid opposite what likely would have been a larger anterolabial protoconid, but the latter cusp is broken such that its anterior part is missing; posterior to the paraconid is a prominent second cusp, the metaconid, and posterior to the latter, but closely appressed and of similar size to it, is a third cusp here considered the metastylid; posterolabial to the protoconid is a prominent, anteroposteriorly elongated cusp likely equivalent to the "stylar cusp" of McKenna (1970:227); and the basin is highly crenulated. A difference from the type species of the genus, on the other hand, is the exceptionally large and bulbous hypoconid that occupies not only the posterolabial corner of the tooth, but continues lingually with an extension (a subsumed hypoconulid?) that nearly meets with the entoconid situated posterior to the metastylid. In this feature, the tooth more closely resembles the m3 of *E. philotau*. The entoconid is separated from metastylid by a small, anteroposteriorly compressed and transversely elongate cuspule. Also different is the apparent absence of any cingulum on the Toledo Bend tooth, so prominent on the labial surface of the p4-m2 of *E. philotau*; the tooth is, however, somewhat water-worn.

AGE OF *EKGMOWECHASHALA*

Ekgmowechashala philotau is known primarily from specimens recovered from the early Arikareean "Wounded Knee-Sharps Fauna" (Macdonald 1963, 1970) in the middle and upper Sharps Formation of southwestern South Dakota, which, based on Tedford et al. (1996), is dated between 28.5 and 29 Ma (C10n-C10r of Berggren et al. 1995 time scale). These South Dakota specimens include lower dentitions only. What is known of the upper dentition is based on three associated teeth described by Rose and Rensberger (1983) from the John Day Formation of central Oregon. Although the Oregon teeth were not found in association with any lower dentition, the referral to *Ekgmowechashala* was based on the congruency of age, size, and matching occlusion with the lower dentitions from South Dakota. Rose and Rensberger (1983:fig. 1) noted that the John Day specimen came from above the Deep Creek Tuff, which has been dated by C. Swisher using the single crystal laser fusion $^{40}Ar/^{39}Ar$ method at 27.89 0.57 Ma. Finally providing strong corroboration of Rose and Rensberger's taxonomic referral, a lower second molar of *E. philotau* was recently found in the Turtle Cove Member of the John Day Formation stratigraphically below the Deep Creek Tuff, but above the Picture Gorge Ignimbrite, also dated by Swisher at 28.7 0.07 Ma (T. Fremd, pers. commun., 1998). Further constraint on the age of this particular specimen is provided by its recovery from informal lithostratigraphic Unit H (Fremd et al. 1994) of the Turtle Cove Member, which is reversely magnetized and correlated to chron C9r (Albright et al. 2000). These data firmly constrain the age of this m2 and thus place *E. philotau* in the John Day region at about 28 Ma, or during the early early Arikareean (Ar1 following Woodburne & Swisher 1995). Although *E. philotau* appears to have been present in the Great Plains region slightly earlier than in the John Day region, it is highly doubtful that the temporal range of such a poorly known taxon can be established to a confident degree of accuracy at this time. In general, therefore, *E. philotau* likely occurred in the John Day and Great Plains regions over a similar interval during the middle Oligocene.

The age of the Toledo Bend specimen, on the other hand, is not as well constrained as those from Oregon and South Dakota due to difficulties in accurately dating Arikareean localities in the Gulf Coastal Plain (Albright 1998a). The only Arikareean site in the Gulf Coastal Plain that has been dated using analytical techniques is the White Springs locality of northern Florida (Morgan 1989, 1993, 1994; Albright 1998a; MacFadden & Morgan 2002) from which Jones et al. (1993) obtained a $^{87}Sr/^{86}Sr$ date on mollusk shells of 24.4 Ma (= late Ar2). The White Springs mammalian fauna is consistent with this age and thus provides a dated baseline against which all other Arikareean faunas from the Gulf Coastal Plain

can be temporally arranged, primarily on the basis of the stage of evolution of their mammalian constituents. Relative to White Springs, the Toledo Bend Local Fauna appears to be slightly younger – perhaps early late Arikareean (early Ar3). This places *Ekgmowechashala* in the Gulf Coastal Plain about 4 million years later than in the northern Great Plains and Pacific NW.

However, there appears to be some discrepancy between the ages of currently known Gulf Coast Arikareean faunas and those of the more accurately dated Great Plains and John Day sequences that share similar taxa. In general, Gulf Coast Arikareean faunas when temporally arranged relative to the dated White Springs fauna, appear to be younger by 3-4 million years than Great Plains and John Day faunas thought to be correlative on the basis of similar taxa. This leads one to question the prudence of relying on the single $^{87}Sr/^{86}Sr$ date for White Springs as it pertains to the temporal placement of the other Gulf Coastal Plain Arikareean faunas; i.e., is the 24.4 Ma strontium date in fact too young? This problem is addressed in further detail in Tedford et al. (2004). On the other hand, the Toledo Bend species does not appear to be referable to *E. philotau* and may indeed represent a second, perhaps younger species. Confirmation of this will require the recovery and study of additional material.

DISTRIBUTION

McKenna (1990:229) discussed the environmental conditions under which *E. philotau* may have lived and found it a "matter of some interest" given that the depositional environment of the Sharps Formation in South Dakota is generally considered to be indicative of a relatively temperate to arid setting with forests restricted to river courses – quite different than the tropical to subtropical conditions of the Clarkforkian to Chadronian in this region. Paleoenvironmental conditions in Oregon under which deposition of the Turtle Cove Member of the John Day Formation occurred were evidently somewhat similar to those in South Dakota. Bestland and Retallack (1994), using faunal, floral, and paleosol data, concluded that the environmental setting of the Turtle Cove Member was one of grassy deciduous forests with a desert scrub element and seasonally wet bottomlands (semiarid to subhumid). Unlike older omomyids and plagiomenids, *Ekgmowechashala philotau* was living in an environment that resulted from the mid-latitude cooling and drying conditions that followed the Eocene-Oligocene climatic transition – conditions due primarily to the opening of the Drake and Tasmanian passages (e.g., Prothero and Berggren 1992; Zachos et al. 1994, 2001).

However, during this interval, the western Gulf Coastal Plain where the Toledo Bend fauna thrived, was still a lush, tropical to semi-tropical, fluvially-dominated, coastal lowland as determined by the great abundance of aquatic turtles, crocodilians, and tapirs, as well as by the browsing nature of all ungulates recovered (Albright 1994, 1999). Although the Gulf Coastal Plain and the High Plains represented quite different physiographic provinces during this time, there are still several taxa, at least at the generic level, in the Toledo Bend Local Fauna that also were present in the Great Plains, including *Daphoenodon*, *Arretotherium*, *Dinohyus*, *Nanotragulus*, *Nexuotapirus*, and *Diceratherium*. The same can be said of the John Day region of Oregon – very different environmental conditions than those of the Gulf Coast, but still having some taxa in common, such as *Moropus* cf. *oregonensis*, *Daphoenodon*, *Dinohyus*, *Nanotragulus*, and *Diceratherium* (*Nexuotapirus* also occurs in the John Day region, but not until the Hemingfordian). The presence, therefore, of a primate *or* a plagiomenid in the Gulf Coastal Plain during the "middle" Arikareean does not at first follow with what is known of at least the plagiomenids' more northerly distribution and, for *E. philotau*, apparent habitat preference. All of the plagiomenids noted above, and *E. philotau*, have a northern US and southern Canadian distribution, and the geographic occurrence of *Ekgmowechashala* prior to the Toledo Bend discovery was limited to between 43° and 45° north latitude. But the occurrence of those taxa noted above that mutually occur in Oregon, the High Plains, and the western Gulf Coastal Plain, including some known only from the High Plains prior to discovery of the Toledo Bend fauna, removes the anomalous aspect of a southerly ekgmowechashaline presence.

CONCLUSIONS

An isolated lower tooth found while screen-washing matrix from the Arikareean Toledo Bend site in easternmost Texas appears to be referable to *Ekgmowechashala*, a taxon that has been questionably referred to either the Plagiomenidae or the Primates, but with the latter currently more accepted. Subtle differences in morphology between the tooth from Toledo Bend and those of the type species of the genus, *E. philotau*, suggest that the former may represent a sec-

ond species. Such limited material, however, precludes naming a new taxon at this time.

Although the Toledo Bend site is not able to be dated as accurately as sites in central Oregon and South Dakota, the Gulf Coast taxon appears to have lived about 3 to 4 my after *Ekgmowechashala philotau*. The paleoenvironmental settings in which the two taxa lived were quite different, as well, with *E. philotau* apparently inhabiting semiarid to subhumid regions in what are now northerly US latitudes, whereas the Toledo Bend taxon lived under tropical to sub-tropical conditions at southerly US latitudes. This is not unusual, however, because there are several taxa, at least at the generic level, that mutually occur at all three localities. It is hoped that renewed screen-washing of matrix from the Toledo Bend site will result in the recovery of additional material that can provide a more definitive identification of this odd little mammal, as well as shed new light on its broader phylogenetic affinities. If future research on heretofore undiscovered and/or unstudied specimens finds that *Ekgmowechashala* is in fact a primate, then in all likelihood the Toledo Bend species will indeed be "the last North American primate."

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