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An Upper Cretaceous (middle Campanian) marine chondrichthyan and osteichthyan fauna from the Rattlesnake Mountain sandstone member of the Aguja Formation in West Texas

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ABSTRACT

A thin phosphate-granule conglomerate within the Upper Cretaceous (middle Campanian) Rattlesnake Mountain sandstone member of the Aguja Formation preserves a diverse chondrichthyan and osteichthyan fauna. This highly fossiliferous deposit (the 'Ten Bits Microsite') yielded about 5000 teeth, spines, and denticles in a small amount of matrix (c. 150 kg). About 30 identifiable species of sharks, rays, and bony fishes are recognized. Two of the three most abundant chondrichthyan species at Ten Bits (*Scapanorhynchus texanus* and *Ischyrhiza mira*) are also the most common species in other middle to late Campanian marine vertebrate faunas along the Gulf and Atlantic Coastal Plain. The myliobatiform rays *Brachyrhizodus* and *Rhombodus* that occur at Ten Bits also appear to be characteristic of the Gulf and Atlantic Coast, as are lamniform sharks such as *Cretalamna* and *Serratolamna*. These taxa are entirely absent or extremely rare in Western Interior Campanian faunas. In contrast, some small orectolobiform sharks (*Cantioscyllium*, *Chiloscyllium*, *Columbusia*) and small rays (*Protoplatyrhina*) found at Ten Bits are common in shallow water faunas of the Western Interior and Texas Coastal Plain, but rarely reported from the eastern Gulf or Atlantic Coast. The common Western Interior ray *Myledaphus bipartitus* does not occur at Ten Bits or in any Gulf or Atlantic Coast fauna. *Ptychotrygon agujaensis* is abundantly represented in the Ten Bits fauna, but unknown in correlative marine faunas. Although *Ptychotrygon* occurs in all Western Interior, Gulf and Atlantic Coastal Plain faunas, it is represented elsewhere by apparently endemic species at each collection site. The differences between Western Interior, Gulf, and Atlantic Coastal Plain faunas probably reflect latitudinal variation in water temperature or salinity, or different oceanic water circulation patterns between the Western Interior Seaway and the Gulf or Atlantic Coast that restricted the distributions of some marine fish species. The Ten Bits fauna shares typical species with both Western Interior and Gulf and Atlantic Coast faunas, reflecting its position at the border between these provinces; however, the dominant taxa found at Ten Bits are the same as those found on the Gulf and Atlantic Coast, and indicate that western Texas was more closely allied biogeographically with that province than with the Western Interior of North America. One species tentatively identified in the Ten Bits fauna on the basis of a single tooth, *Igdabatis* cf. *I. indicus*, is otherwise known only from southern Europe and Asia, although a similar large myliobatid ray also occurs rarely in Texas Coastal Plain faunas. These occurrences indicate that western Texas may have been near the northern limit of the range for some tropical Tethyan marine vertebrate species.

1. Introduction

Remains of fossil selachians and bony fishes are relatively common in Upper Cretaceous marine strata throughout western North America. Although similar remains have been reported from the Upper Cretaceous Aguja Formation in the Big Bend region of West Texas, only a few specimens from the upper part of the

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formation have been illustrated (e.g., Rowe et al., 1992; Sankey, 2008), and no thorough account of the Aguja Formation chondrichthyan and osteichthyan fauna has been previously presented. Although contemporaneous selachian and bony fish assemblages are known from sites farther north on the Great Plains, and also farther east on the Atlantic and Gulf Coastal Plains (e.g., Case, 1978; Case and Schwimmer, 1988; Robb, 1989), the Aguja Formation marine fauna is of particular interest because it provides a sample from the southernmost margin of the Western Interior Seaway in North America. The Aguja Formation fauna offers an opportunity to compare marine vertebrate faunas in these disparate biogeographic provinces. The present description focuses on a marine fish fauna collected from the middle part of a heretofore poorly-sampled stratigraphic interval of the Aguja Formation; the Rattlesnake Mountain sandstone member of Lehman (1985).

2. Geologic setting

The Aguja Formation is an eastward-thinning series of paralic and marine sandstones interbedded with shale and lignite, and reflects deposition in varied shallow marine and coastal plain environments along the western shore of the Western Interior Seaway during Campanian time. The fossil vertebrate fauna of the Aguja Formation is generally well known and includes a wide variety of terrestrial and marine animals (e.g., Lehman, 1985; Rowe et al., 1992; Sankey, 2008; Wick et al., 2015 and referenced therein); however most of the vertebrates recovered occur in the uppermost terrestrial and coastal floodplain facies (upper shale member of Lehman, 1985) which developed landward of the shoreline of the Western Interior Seaway.

Lehman (1985) separated the terrestrial and paralic sediments of the Aguja Formation into several informal members that reflect two major progradational intervals separated by a marine tongue of the Pen Formation (Fig. 1). The Rattlesnake Mountain sandstone member is a thin (c. 10 m) transgressive marine unit, deposited in a shallow marine shelf environment and exposed in the western Big Bend region. The fossil assemblage described in this report was collected at a site on the Ten Bits Ranch, about 15 km north of Study Butte in Brewster County, Texas (TMM 46018, Fig. 1). A partial section of the Aguja Formation is exposed here (Fig. 1); however, the uppermost portion of the formation is truncated by erosion. The collection site, herein referred to as the 'Ten Bits Microsite', occurs within the middle of the Rattlesnake sandstone member along the base of a thin phosphate-granule conglomerate horizon where abundant teeth and abraded bone fragments are preserved in a thin winnowed 'lag' deposit.

The fossil concentration is well sorted with only a few larger bones preserved, and most of the specimens represent hydraulically equivalent objects, typically less than 10 mm in diameter (Fig. 2). Owing to the energetic depositional setting, many specimens are fragmentary and exhibit a high degree of pre-burial abrasion, while others preserve delicate cusps and fine surface detail. Most of the teeth are identifiable in spite of their abraded condition, and examples of even indeterminate taxa are described and illustrated herein to document the entire composition of the Ten Bits fauna. In addition to teeth, spines, and denticles, the bone concentration also includes granules of non-skeletal phosphate, phosphate-cemented sandstone nodules, and phosphatized steinkerns of marine invertebrates (gastropods, baculitid ammonites). This deposit probably represents the shoreward limit of an extensive but thin stratigraphic 'condensed horizon' developed at the maximum flooding surface within the correlative McKinney Spring marine tongue of the Pen Formation (Fig. 1). Although this marine shale tongue is very thin in nearby areas, it has pinched out entirely in the vicinity of the Ten Bits Microsite. Becker et al. (2006) and Cicimurri et al. (2014) described similar skeletal phosphate 'lag' accumulations associated with maximum flooding surfaces in other strata.

3. Methods

Although some specimens were initially collected at the Ten Bits Microsite by 'surface picking', the bulk of the sample was obtained via wet screening. Approximately 100 kg of matrix was processed on-site at a field laboratory on the Ten Bits Ranch. This sample was screened through stacked 6 mm and 0.8 mm screens; the residual concentrate was examined, and specimens collected with forceps using a binocular microscope. An additional 45 kg of matrix was transported to Texas Tech University for similar wet screening, with 5 kg of this matrix using finer mesh. This concentrate was hand picked using a binocular microscope for particularly small fossils not retained on the coarser mesh sizes. Larger teeth and other skeletal elements figured herein were photographed using a digital camera with the binocular microscope. Smaller specimens were

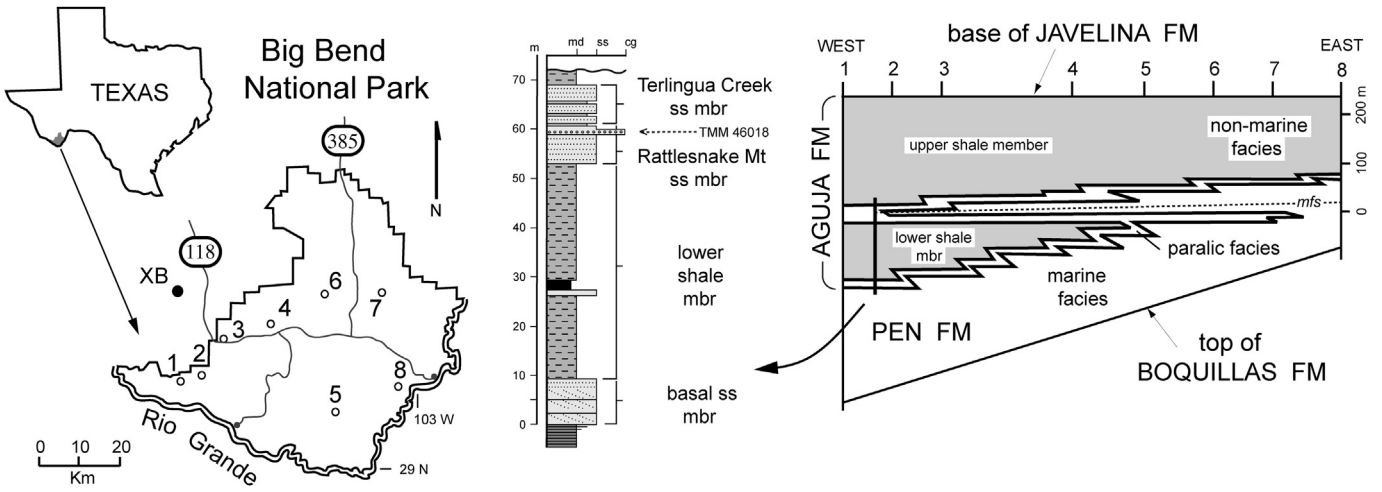

Fig. 1. Map (left) showing location of Ten Bits Microsite (XB) west of Big Bend National Park in Texas, and general stratigraphic relationships of Aguja Formation (right) with position of regional phosphate granule conglomerate bed developed on maximum flooding surface (mfs); stratigraphic section (center) measured at the Ten Bits Microsite shows informal subdivisions of Aguja Formation and level of TMM 46018.