

A HEXANCHID SHARK FROM THE LATE CRETACEOUS PIERRE SHALE GROUP OF THE WESTERN INTERIOR SEAWAY OF NORTH AMERICA

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ABSTRACT

An unusual occurrence of a hexanchid shark, *Notidanodon*, was discovered below a skeleton of *Mosasaurus missouriensis* along the shores of the Missouri River in central South Dakota. Both vertebrate fossils were derived from the lower DeGrey Formation of the Pierre Shale Group above the Crow Creek Member. The shark tooth was found slightly below the skeleton and so cannot be considered directly associated with the mosasaur; however, hexanchid shark teeth have been found associated with marine reptiles elsewhere. Therefore, the tooth may have been shed during scavenging of the mosasaur carcass. The tooth represents a rare occurrence of a cow shark from the Cretaceous portion of the North American Western Interior Seaway. Because hexanchids normally prefer deeper water, the occurrence is somewhat surprising in the middle of the former seaway in the shallow marine waters of the DeGrey Formation, although hexanchids are known to range into shallower waters.

Keywords

Cretaceous Western Interior Seaway, hexanchid, Pierre Shale Group, South Dakota

INTRODUCTION

In 1996, a nearly complete skeleton of the mosasaur, *Mosasaurus missouriensis*, was collected from central South Dakota. During preparation of the skull, William R. Schurmann, a volunteer at the SD School of Mines and Technology (SDSM) noticed a shark tooth occurring 50 mm below the skull posterior to the orbit (Figure 1A). Upon inspection, the tooth was recognized to be that of a cow shark, an unusual occurrence in shallow marine waters, and the purpose of this contribution is to place this unusual occurrence on record. Both the shark and the mosasaur were found in the lower DeGrey Formation of the Late Cretaceous Pierre Shale Group (Martin et al., 2007) from 1.4 m above the lower Crow Creek sandstone. The specimen was found on the Crow Creek Sioux Indian Reservation

and collected with their permission along the Big Bend of the Missouri River, the type area of *Mosasaurus missouriensis* (Martin 2004a,b; Patrick et al., 2007).

DESCRIPTION

SDSM 86930 was assigned to an upper anterolateral tooth of a hexanchid chondrichthyan characterized by a saw-tooth arrangement of cusps (Figure 1B). In this case, five cuspsules lie mesial to a large central cusp that obliquely angles distally. The principal cusp is succeeded by four sharply pointed, smaller distal cusps. The crown base is not straight, but curved rather tightly apically (Figure 1B), as a result the cusps are also curved apically. The tooth extends 20 mm from the mesial crown tip to the distal tip. The preserved height of the tooth crown is 17.5 mm, whereas the height of the principal cusp crown is 11.9 mm. The second largest cusp is 9.5 mm high, lies distal to, and is well divided from the principal cusp. This cusp and the three successive distal cusps are obliquely curved distally. The third highest cusp is 7.0 mm high and lies mesial to the principal cusp. Unlike the curved distal cusps, the four mesial cuspsules are bilaterally symmetrical.

DISCUSSION

The morphology of SDSM 86930 greatly resembles that of upper anterolateral teeth of other Cretaceous hexanchids, particularly those of *Notidanodon* and *Notorhynchus* (Capetta 2012). However, the sharply curved cusp row along the apical base margin appears unique, and the occurrence of four cusps distal to the principal cusp rather than three is unusual as is the occurrence of five rather than four cusps mesial to the principal cusp. SDSM 86930 resembles an upper anterolateral tooth of *Notidanodon* in having the principal cusp and that cusp lying just distal widely separated and both cusps strongly curved distally. The tooth of *Notidanodon* (Capetta 2012: fig. 83) does exhibit slightly apically curved cusps like those of SDSM 86930, although not as strongly curved and decidedly unlike the straight crown base of *Notorhynchus*. Therefore, SDSM 86930 appears most likely assignable to *Notidanodon* (Cione 1996; Capetta 2012), although it differs from most known species in number of cuspsules and degree of crown base curvature. The tooth may represent that of an unknown species, but based upon the unknown range of variation, species designation based upon a single tooth could be premature.

This tooth represents the second discovery of a hexanchid shark in sediments deposited in the Late Cretaceous North American Western Interior Seaway. *Hexanchus microdon*, a smaller hexanchid, was found from Campanian and Maastrichtian deposits much farther south in Texas (Welton and Farish 1993). Both occurrences are rather surprising because hexanchids most commonly occur in deep water, rather than shallow shelf environments. However, they can occur in shallower waters, and hexanchids (*Notorhynchus*) have been found in the Paleocene Cannonball sediments in North Dakota (Cvancara and Hoganson 1993).

Also, teeth of *Notidanodon* have been observed associated with plesiosaur material in Antarctica (per. observ.). Therefore, although equivocal because the tooth was found slightly below the mosasaur skeleton, the tooth may have been lost during scavenging of the mosasaur carcass.



A

2 cm



B

1 cm

Figure 1. A) SDSM 86930, a shark tooth (circled), lying posterior to the orbit of *Mosasaurus missouriensis*. B) SDSM 86930, upper anterolateral tooth of *Notidanodon* sp.

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LITERATURE CITED

- Capetta, H. 2012. Chondrichthyes II (Mesozoic and Cenozoic Elasmobranchii: Teeth). Handbook of Paleoichthyology Vol. 3E, Stuttgart: Pfeil 512 p.
- Cione, A.L. 1996. The extinct genus *Notidanodon* (Neoselachii, Hexanchiformes) in Arratia, G., and G. Viohl (eds.), *Mesozoic Fishes-Systematics and Paleobiology*. Verlag Pfeil, Munchen p. 63-72.
- Cvancara, A.M., and J.W. Hoganson. 1993. Vertebrates of the Cannonball Formation (Paleocene) in North and South Dakota. Jour. Vert. Paleont. 13(1):1-23.
- Martin, J.E. 2004a. The first marine reptile from the American West, a mosasaur: *Mosasaurus missouriensis* (Harlan) 1834; its history, source and osteology. Geol. Soc. Amer., Rocky Mtn. & Cordilleran Secs., Abstr. with Progr. 36(4):68.
- Martin, J.E. 2004b. The type of *Mosasaurus missouriensis* compared with other mosasaur specimens from the Missouri River area of central South Dakota. Jour. Vert. Paleont., Abstr. 24(3 suppl.):89A.
- Martin, J.E., J.L. Bertog, and D.C. Parris. 2007. Revised lithostratigraphy of the lower Pierre Shale Group (Campanian) of central South Dakota, including newly designated members in Martin, J.E. and D.C. Parris (eds.), *Geology and Paleontology of the Late Cretaceous Marine Deposits of the Dakotas*. Geol. Soc. Amer., Spec. Paper 427:9-21.
- Patrick, D., J.E. Martin, D.C. Parris, and D.E. Grandstaff. 2007. Rare Earth Element determination of the stratigraphic position of the holotype of *Mosasaurus missouriensis* (Harlan), the first named fossil reptile from the American West. in Martin, J.E. and D.C. Parris (eds.), *Geology and Paleontology of the Late Cretaceous Marine Deposits of the Dakotas*. Geol. Soc. Amer., Spec. Paper 427:155-165.
- Welton, B.J., and R.F. Farish. 1993. *The Collector's Guide to Fossil Sharks and Rays from the Cretaceous of Texas*. Horton Printing Co., Dallas, TX 204p.