A new mosasaur from the Turonian of Texas: Discovery to description

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Introduction

Mosasaurs are a group of secondarily marine adapted lizards that lived in the upper Cretaceous period (the last age of the dinosaurs). The earliest known forms are small, about a meter long, and able to walk on land, similar in appearance to modern monitor lizards [1]. Like in the evolution of whales, mosasaurs rapidly evolved aquatic adaptations, and through their evolutionary history, achieved significant morphological disparity, reflecting resource partitioning, prey acquisition and feeding style. In doing so, they achieved global distribution and occupied several feeding niches [2]. The evolution of the earliest mosasaurs is poorly understood, and the research of Michael J. Polcyn at SMU aims to fill some of those gaps. Professor Polcyn has named and described several early mosasaurs, including the oldest known from Israel [3] and others from Texas, Kansas, and Utah [4-6].

This made Professor Polcyn an excellent mentor for me, with my existing interest in the subject and the fossil material I could contribute. My internship is focused on describing a new genus (and species) of mosasaur that my stepbrother and I discovered two years ago. This is an important specimen that may help clarify basal relationships of two major subfamilies of these marine lizards.

Purpose and Objectives

Our overarching objective with the research of this skeleton was to describe its osteology, document its geological age, and infer its phylogenetic position. Initial assessments by professor Polcyn suggest it is a new species (and a new genus). The study of this animal allows us to document morphological characters that may bear on the relationships of multiple subfamilies, since our animal possesses characters known in two of the four main subfamilies of mosasaurs - the Plioplatecarpinae and the Tylosaurinae. Skeletons like this often do more than that though, since fossil preparation may reveal unexpected features that drive additional questions we had not considered. The rarity of mosasaur fossils of this age underpins its importance.

Literature Overview

In 2005, Polcyn and Bell [4] erected the parafamily Russelosaurina, to include Plioplatecarpinae, Tylosaurinae, their common ancestor and all descendants. This grouping demonstrated common ancestry between two of the four mosasaur subfamilies (Plioplatecarpinae and Tylosaurinae) while simultaneously demonstrating that the other two subfamilies, Mosasaurinae and Halisaurinae, had independent evolutionary trajectories from Russelesaurina [4]. In 2008, Polcyn et. al explored Turonian reports of North American mosasaurs, establishing that Plioplatecarpinae and Tylosaurinae diverged during the middle Turonian [5], but later evidence from the 2023 description of the early Turonian *Sarabosaurus dahli*, now the oldest described North American mosasaur, suggested that the plioplatecarpine-tylosaurine divergence occurred during the late Cenomanian or earliest Turonian [6].

Methods and Procedures

The fossil was collected in the field using hand tools and battery powered roto-hammers. Fossil preparation and conservation has been undertaken at Southern Methodist University. This process entails removing the encasing rock and hardening the bones with consolidants. We used pneumatic and hand tools for rock removal, and measurements are taken with digitals calipers for objects smaller than 100mm, while larger objects are measured with metal scales. The specimen is then assessed for a range of trait expressions for certain skeletal features compared with many mosasaur species.

I spent most of my time studying the quadrate, which functions as both the ear bone and hinge for the lower jaw, because it's a complex structure that has a lot of morphological variation among mosasaurs. The task involved describing and comparing the morphology of the quadrate, then coding the relevant characters in a character-taxon matrix for a later phylogenetic analysis. My involvement in the project is not over, we will see this paper completed together, so I get to take part in one of the next important stages coming up after fossil preparation (which is still ongoing) completes. We will do a thorough phylogenetic analysis and employ geometric morphometrics, a technique for quantifying shape by pinning data points (landmarks) on the equivalent parts of multiple specimens and then using statistical techniques to compare the morphology.

Preliminary results/findings

We have established through comparisons that this animal is a new species, and though a bit more uncertain without running a phylogenetic analysis, a new genus. It may prove to be a basal member of the Plioplatecarpinae or Tylosaurinae subfamilies. It is also possible the animal represents a branch outside of those two subfamilies, but in any event, it will help us document the morphological evolution of the mosasaurs and help polarize the observed character evolution. Preparation and research of the fossil is still ongoing.

Conclusions and personal changes

Research of this fossil will improve our understanding of mosasaur basal relationships and provide some insight into how mosasaurs adapted along changing paleogeography, paleoclimatology, paleoecology. Personally, I now understand the scope of the science better, and see what the life and career of a researcher in vert paleo is like. I now know how to prepare fossils, and my field excavation skills have become applicable and more robust, and I came away with a much greater knowledge of Mosasaur biology.

My science communications abilities learned from the internship were invaluable - my videos about this specimen have gone viral, and interest that's generated about science from science communications like this may inspire others to explore science recreationally or even pursue it professionally.

References

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