ACTA PALAEONTOLOGICA POLONICA

Paper review

Vol. 44, No. 3, pp. 347–348, Warszawa 1999

Mosasaur bites or punctured limpet home scars?

Tomoki Kase, Paul A. Johnston, Adolf Seilacher, & Japeth B. Boyce, 1998. Alleged mosasaur bite marks on Late Cretaceous ammonites are limpet (patellogastropod) home scars.
Adolf Seilacher, 1998. Mosasaur, Limpets or Diagenesis: How *Placenticeras* shells got punctured.

One of the best known examples of the fossil predatory behavior is that of the supposedly mosasaur-bitten ammonite *Placenticeras* from the Late Cretaceous of South Dakota described by Kauffman & Kesling (1960). The ammonite bears numerous perforations and the apertural one-third of the right side of its body chamber is crushed. Even a superficial glance at the left side of the ammonite reveals a V-shaped set of punctures strikingly similar to that which would have been left by the teeth of a giant reptile. Also, there are sets of small traces which look like imprints of mosasaur pterygoid teeth. Consequently, the punctures were interpreted by Kauffman & Kesling (1960) as made by a mosasaur. The crushed aureolae around the punctures were thought to have been the traces of mosasaur tooth bases.

According to Kauffman & Kesling (1960), the arrangment of holes indicates that the ammonite was bitten repeatedly. They reconstructed the biting sequence, and distinguished at least 16 successive bites. The sequence of first 14 bites started with 'scissors'-type bites, followed by 'nutcracker' and, finally, 'gulp' bites, the latter expressed by traces of the pterygoid teeth. The sequence resulted from the mosasaur's attempts to swallow the cephalopod. This proved to be impossible, however, due to the large size of the prey. The reptile finally crushed the ammonite body chamber (bites 15 and 16), dislodged soft parts, and ate them.

Kauffman & Kesling (1960) admitted some problems with their interpretation. The spacing of the supposed pterygoid teeth was unusually close as compared with that of known mosasaurs and the number of marginal teeth – in contrast – fewer than in any known mosasaur. Additional punctured specimens were found after the paper of Kauffman and Kesling was published. None of them, however, revealed the mosasaur-type, V-shaped alignment of punctures. Despite all these problems, the mosasaur interpretation has been widely quoted as a classical example of a fossilized predator-prey interaction. The punctured ammonites were discussed in the context of the mosasaur behavior and jaw-mechanics (e.g., Massare 1987; Lingham-Soliar 1995) and of the supposed coevolution of mosasaurs and ammonites (e.g., Kauffman 1990).

Kase *et al.* (1998) and Seilacher (1998) proposed another interpretation of the punctured ammonites. They studied *Placenticeras* specimens infested by patellogastropod limpets. In some cases, the limpet shells were still attached; in other only round limpet home scars were present (some with radula-markings). Most importantly, the shape and size of the limpet pits match the alleged tooth marks very well. According to Kase *et al.* (1998) and Seilacher (1998) the punctures visible on the shells of the 'mosasaur-bitten' ammonites are the result of a compactional crushing of the limpet home scars. Also, the crushing of the body chamber seems to result from compaction rather than mosasaur bites. These conclusions are supported by actualistic experiments with *Nautilus* shells crushed by 'mosasaur' robotic jaws, conducted by Kase *et al.* (1998). The experimental holes show jagged edges rather than crushed aureolae present in the *Placenticeras* specimen.

Proponents of the limpet interpretation explain the teeth-like arrangement of the punctures as a purely accidental one, resulting from the prefered limpet attachment along successive water lines during the time when the empty, vertically oriented ammonite shell drifted on the sea-surface and changed its buoyancy as it became gradually filled with water (necroplanctic stage). They also consider a thermocline, an oxycline, and an anterior margin of the ammonite's mantle tissue extended from the body chamber, as possible factors that may have controlled the alignment of limpets (Kase *et al.* 1998).

We are thus faced with two contradictory interpretations of punctured *Placenticeras* specimens. The 'limpet' interpretation seems to be much better supported, especially in the light of the limpet-infested ammonite finds and the crushing experiments with recent *Nautilus* shells. There are, however, some problems as well:

(1) It is questionable that the floating ammonite shell could have maintained a stable position (i.e., a constant relation to any environmental interface) long enough to allow for an alligned growth of limpets. A 'necrobenthic stage' with an ammonite shell trapped vertically in the bottom sediments would be more probable explanation for the aligned growth of limpets (slightly above the sediment/water interface). Indeed, vertically embedded ammonites do occur in the fossil record (e.g., Seilacher 1971).

(2) There is no evidence that the mantle of *Placenticeras* extended into the external wall of the shell.

(3) Most importantly, however, the 'limpet' interpretation fails to explain the supposed pterygoid teeth imprints reported by Kauffman & Kesling (1960). What additionally complicates the matters is that these imprints look artificial, unlike the larger punctures. They typically show rectangular outline (Kauffman & Kesling 1960: pl. 3: 2; Kauffman 1990: fig. 167) rather than suboval one that would be expected from the actual shape of the mosasaur pterygoid teeth. There is no comment on supposed pterygoid imprints neither in Kase *et al.* (1998) nor in Seilacher (1998).

The pterygoid problem obviously needs clarification before the limpet hypothesis is fully accepted. The examination of the crucial ammonite specimen described by Kauffman & Kesling (1960) certainly would be helpful in resolving the problem, but it is reported to be lost (Kase *et al.* 1998).

References

Kase, T., Johnston, P.A., Seilacher, A., & Boyce, J.B. 1998. Alleged mosasaur bite marks on Late Cretaceous ammonites are limpet (patellogastropod) home scars. — *Geology* **26**, 947–950.

Kauffman, E.G. 1990. Mosasaur predation on ammonites during the Cretaceous: An evolutionary history. *In*: A.J. Boucot (ed.), *Evolutionary paleobiology of behavior and coevolution*, 184–189. Amsterdam, Elsevier.

Kauffman, E.G. & Kesling, R.V. 1960. An Upper Cretaceous ammonite bitten by a mosasaur. — *Contributions from the Museum of Palaeontology, University of Michigan* **15**, 193–248.

Lingham-Soliar, T. 1995. Anatomy and functional morphology of the largest marine reptile known, *Mosasaurus hoffmanni* (Mosasauridae, Reptilia) from the Upper Cretaceous, Upper Maastrichtian of The Netherlands. — *Philosophical Transactions of the Royal Society of London, Biological Sciences* **347**, 105–124.

Massare, J.A. 1987. Tooth morphology and prey preference of Mesozoic marine reptiles. — *Journal of Vertebrate Paleontology* **7**, 121–137.

Seilacher, A. 1971. Preservational history of ceratite shells. — *Palaeontology* **14**, 16–21.

Seilacher, A. 1998. Mosasaur, Limpets or Diagenesis: How *Placenticeras* shells got punctured. — *Mitteilungen aus dem Museum für Naturkunde in Berlin, Geowissenschaftliche Reiche* **1 (1998)**, 93–102.

Marcin Machalski [mach@twarda.pan.pl], Instytut Paleobiologii PAN, ul. Twarda 51/55, PL-00-818 Warszawa, Poland.