Research Questions

(1) Do bivalves exhibit increased ornamentation throughout the Cretaceous, suggesting a possible morphological response to the diversification of predators?

(2) Do ornamentation trends in Cretaceous bivalves differ based on epifaunal or infaunal life habit?

(3) Are more ornamented bivalves less likely to go extinct than smooth ones, suggesting that increased ornamentation may be advantageous against predation for Cretaceous bivalves?

What did we do?

Using taxonomic data on Cretaceous bivalves from the Paleobiology Database as a guide, we searched for examples of Cretaceous bivalves in the primary literature. We assigned ornamentation scores for six different types of ornamentation: ribbing, folding, spines, tubercles, smoothness, and auricles. For ribbing, folding, and spines, ornamentation scores were determined by the degree of ornamentation (major, minor, absent). For tubercles, smoothness, and auricles, the presence or absence of such ornamentation was scored. The overall ornamentation value per species is the sum of all scores.

What did we learn so far?

Evolutionary trends in morphology may serve as indicators of interactions between predators and their prey. During the Mesozoic Marine Revolution, bivalves are thought to have faced increased predation from shell-crushing crinoids, drilling gastropods and teleost fishes, particularly near the end of the Mesozoic (Vermeij, 1977). Experiments have shown that ornamentation features on bivalves, such as ribbing, folds, and spines, can be effective against predators. To test the hypothesis that bivalve ornamentation increased throughout the Cretaceous in response to diversification of predators, we assembled a database scoring the ornamentations (presence and strength of ribs, folds, spines, tubercles, smoothness and auricles) of ~500 Cretaceous bivalve species. Epifaunal bivalves show no evidence of increased ornamentation throughout the Cretaceous, while ornamentation of infaunal bivalves may decrease slightly, perhaps indicating increased infaunalization. Using similar methods, we would like to investigate how different types of bivalve ornamentation change towards the end of the Jurassic (Aberhan, 1994; Aberhan et al., 2006). The lack of strong trends in all bivalves and epifaunal bivalves combined with our findings that degree of ornamentation is not an important factor in determining extinction selectivity suggest that any morphological responses to diversification of predators during the Cretaceous were either lineage-specific or delayed until the Cenozoic.

Introduction

The Mesozoic marine revolution marked the peak of diversity and productivity of marine ecosystems (Hunt, 2014). Species richness increased fivefold across the Mesozoic, resulting in the diversification of many invertebrates such as gastropods, cephalopods, and crustaceans. With a similar increase in predator diversity, it is likely that predation was a major force in the diversification of Mesozoic marine benthic ecosystems. Infaunalization has been suggested as an evolutionary response to increased predation (Vermeij, 1977; Aberhan, 1994; Aberhan et al., 2006). Infaunal organisms, by the nature of their life habit, are out of the reach of many surface-dwelling predators. An increase in infaunalization has also been documented in bivalves towards the end of the Jurassic (Aberhan, 1994; Aberhan et al., 2006). The question of whether all bivalves and epifaunal bivalves combined with our findings that degree of ornamentation is not an important factor in determining extinction selectivity suggest that any morphological responses to diversification of predators during the Cretaceous were either lineage-specific or delayed until the Cenozoic.

Where do we go from here?

Using similar methods, we would like to investigate how different types of bivalve ornamentation change throughout the Cretaceous. Although the data originates mostly from Europe and North America, uncovering potential latitudinal trends may be another research avenue (see Vörös, 2014, for Jurassic brachiopods).

References


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