LIFE ON THE EDGE: A MORPHOSPACE EVALUATION OF ANCIENT AMMONITE HYDRODYNAMICS

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Ammonite conch morphology likely affected how these squid-like animals swam and interacted with the world around them, but we have few direct constraints about the relative risks and opportunities presented by different aspects of conch shape. We advance this study by generating hypothetical three-dimensional models of ammonoid conchs in the open-source software Blender. Then we use computational fluid dynamics to simulate water flow around the shells at a practical range of velocities. Trajectory analyses of the simulated drag measurements allow us to speculate on the range of swimming velocities, jet propulsion strategies, and coasting patterns that would have best used these conch shapes. Here, we specifically examine how relative umbilical exposure and whorl expansion impart drag on the conch. Our results add nuance to a long-held assumption that a highly streamlined oxyconic shape is the ideal shell with the lowest drag coefficient overall. Instead, we find that the suite of behavioral advantages when employing an oxyconic shell is fairly limited: intense streamlining imparts reduced drag only once a sufficient size and velocity is reached. Purely serpenticonic forms, in contrast, produce middling drag in these low-speed simulations, and suggest middling escape and coasting ability across a wide range of sizes and target velocities. We present results in the Westermann Morphospace to examine the first-order hydrodynamic risks and opportunities across the serpentine-to-oxycone gradient of conch shapes. This data will further expand previously published experimental and simulation data and clarify next directions for biomechanical investigation.

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