EXPLORING HYDRODYNAMIC CONSEQUENCES OF AMMONITE ORNAMENTATION AND ONTOGENETIC SHAPE CHANGE VIA COMPUTATIONAL FLUID DYNAMICS

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Computational fluid dynamic simulations have proved extremely useful for paleontology in the analysis of extinct marine animals' functional morphology. We present custom workflows to model hydrodynamic consequences of conch shape in ammonoid fossils, using *Dactylioceras commune* as a test case. This species of ammonite displayed dramatic ontogenetic change in gross geometry of the conch coil, while maintaining relatively consistent ornamentation patterns. Past experiments demonstrated that both overall geometry and ornament can alter water flow and relative hydrodynamic efficiency of the conch as a vehicle for locomotion. To address these features independently, we generated three dimensional models of both fossil replica, idealized, and hybrid specimens. First, we used an Arctec Spider scanner to apply rapid automated photogrammetry to a well-preserved fossil of *Dactylioceras commune.* Next, we used open source 3D modeling tools in Blender to refine the replica specimen, then smoothed away the ribs to create a model with unornamented whorl sections. Finally, we used the basic coiling geometry to generate four idealized conch models, each representing a different stage in the ammonite's life. We fitted each conch model with a small cone protruding from the aperture to suggest a mostly-retracted soft-body volume. The four models were analyzed at thirteen different velocities to determine how well *Dactylioceras* was able to function in difference degrees of turbulence at difference stages of life. An additional two models were generated, one with a ribbed conch from the original 3D scan and one with a smooth conch, to assess the effect of ribbing on hydrodynamics. These two models were analyzed at two velocities. The results of this study and the associated workflow are useful for further understanding the evolutionary drivers behind morphological changes through ammonite life cycles and the development of ornamentation.