NEW APPROACHES TO STUDY THE RELATIONSHIPS BETWEEN FUNCTIONAL MORPHOLOGY AND MORPHOLOGICAL TRENDS IN AMMONOID EVOLUTION

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Advances in computer reconstruction, simulations, 3D-printing, and robotics allow the fossil record to be explored with new integrative approaches. Ammonoid cephalopods are ideal targets to investigate using these techniques due to their ecological significance, high evolutionary rates, ubiquity, and the large temporal ranges of higher taxa. Furthermore, their conchs conveniently constrain the volume and shape of the soft body, air filled voids, and chamber liquid, allowing detailed models to be constructed for the analysis of various syn vivo physical properties. The biomechanics of these animals can provide critical evolutionary context to certain morphological changes throughout most of the Phanerozoic. Most ammonoids produced conchs very different from that of the chambered nautilus, a frequently used, modern analogue. Computer reconstructions and hydrostatic simulations demonstrate that cephalopods from majority of the planispiral morphospace are much less stable than *Nautilus*. In contrast, many morphotypes of heteromorphic ammonoids (i.e., those with non-planispiral conchs) are much more hydrostatically stable. These differences suggest that the swimming capabilities and modes of locomotion of these cephalopods were much different from extant *Nautilus*, and also varied between particular morphotypes. During the Late Cretaceous, heteromorph ammonoids flourished, becoming dominant components of many ammonoid faunas. These forms have been linked to favorable trophic conditions, changes in sea level, and episodes of environmental stress. Higher stability and other hydrostatic properties lend important context to their success during these perturbations. The similarity in hydrostatics among many planispirals suggests that prominent changes in their morphology across extinction intervals likely involved selection for certain hydrodynamic properties instead.