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Tube mechanical properties and structural design of Hydroides elegans under multiple stressors

LI, Chaoyi[1*] ; CHAN, Vbs[1] ; MENG, Yuan[1] ; HE, C[2] ; YAO, H[2] ; YEUNG, Kwk[3] ; THIYAGARAJAN, V[1]

[1]Swire Institute of Marine Sciences and School of Biological Sciences, The University of Hong Kong, [2]Department of Mechanical Engineering, The Hong Kong Polytechnic University, [3]Department of Orthopaedics and Traumatology, The University of Hong Kong

Most marine calcifiers construct robust calcareous skeletons or shells through biomineralization to protect themselves from predatory attacks. Due to increased anthropogenic emission of CO_2 in recent years, reduced global ocean pH and decreased carbonate concentration in seawater are expected to impede the CaCO3 accretion in shell formation and produce a mechanically brittle shell structure. In addition, the effect of elevated pCO2 level can act synergistically with temperature and salinity changes in seawater, further affecting the calcification process adversely. To investigate the combined effects of multiple environmental stressors on calcifying marine organisms, we studied the effects of pH (8.1 and 7.8), salinity (34 and 27 ‰), and temperature (23 ℃ and 29 ℃) on the mechanical properties of the tubes built by the tubeworm, *Hydroides elegans*. By employing Micro-CT scanning and micro-force testing, information on tube topography and mechanical properties were analyzed using finite element analysis (FEA). Markedly, despite the structural deterioration observed in reducing pH and salinity, the level of elevated temperature counteracts these effects and even strengthen the overall mechanical properties. This may suggest that warming conditions in the early subtropical summer seawater may rescue the tapeworms from decreasing pH and salinity in the near future.

Keywords: calcifiers, biomineralization, stressors, Hydroides, tubeworm