

Patellogastropod Molluscs Support Multiple Invasions of Deep Sea Habitats

LINDBERG, David R.; GURALNICK*, Robert; HEDEGAARD, Claus, Dept. of Integrative Biology & Museum of Paleontology, University of California, Berkeley, CA 94720, U.S.A.; JACOBS, David, Dept. of Biology, University of California, Los Angeles, CA 90095, U.S.A.

The Patellogastropoda are the most primitive of all Gastropoda based on both morphological and molecular data. Moreover, they are almost exclusively an intertidal and shallow water group. Over 90% of the species are found in 33 m or less. Patellogastropod characters are well known and have been sufficiently studied so that autapomorphies are unlikely to deeply mask relationships. Moreover, shell structure, preserved in both fossil and Recent taxa, is character rich and ecologically invariant. Patellogastropods are the sister taxon of all other gastropods and are therefore assumed to be an ancient lineage. Four patellogastropod taxa have representatives in the deep sea. Patellogastropod taxa at vents and seeps have been previously argued to have ridden vents down from shallow water habitats or are evidence of immigration and colonization from shallow water habitats (onshore - offshore model). Vent fauna could also be aggregates of some 'old' shallow water things that rode the vents down, and colonization from both deep sea and shallow water habitats. It is difficult to test different alternative hypotheses.

Arguments for antiquity of patellogastropods in the deep sea are often based on fossil occurrences of taxonomically similar taxa. This similarity not rigorously tested to determine whether or not it reflects relatedness. Most taxonomies, especially for fossil and living marine invertebrates, do not, but instead have been based on comparison of shell morphologies between fossil and living gastropods. Other evidence marshaled for support of antiquity is based on bizarre and supposedly archaic character combinations found in members of the hot vent faunas.

We examine 12 patellogastropod taxa using parsimony analysis and discover that members of this clade have entered the deep sea on four different occasions. Hot vents and seeps have been colonized twice, wood substrates once, and rock substrates once. All but one taxon has a sister taxon that is still intertidal in habitat. Area cladograms as well as the fossil record suggest that all of these events have been Cretaceous or later.