FORAMS 2010

Keynote Presentation

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08:30 **Kate Darling and Mark Leckie**: *Bridging the benthic/planktic divide*

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Traditionally, all planktic foraminifera have been seen as monophyletic, descending from a single benthic group in the late Early Jurassic. Although limited in resolution, foraminiferal molecular phylogenies hint that this is unlikely to be true. In many ways it would be quite surprising if it were such a singular event since there is constant opportunity to bridge the benthic/planktic divide. The transition zone of the outer continental shelf and upper slope is an area of seasonally high biological productivity and shifting water masses where the thermocline, chlorophyll maximum zone and oxygen minimum zone (OMZ) interface with benthic habitats. This dynamic interface makes it a likely “bridge” for benthic forms to invade the planktic realm.

Buoyancy is generally assumed to be one of the major constraining evolutionary traits on the passage from benthos to plankton. In the modern ocean, propagules of benthic forms are widely dispersed in suspension and a few benthic taxa produce reproductive float chambers containing gametes. Benthic taxa are also regularly observed in plankton tows over the shelf and off the shelf break in turbulent waters. Lacking buoyancy, they are thought to sink back to the benthos as high energy waters subside. But is this true for all of them? Today, microperforate biserial and triserial planktic forms appear off the continental shelf edge in large numbers, often associated with wind driven upwelling. We now know that the biserial forms lead a dual life style as molecular evidence shows that the benthic morphospecies *Bolivina variabilis* and the planktic *Streptochilus globigerus* are the same biological species with the ability to occupy both planktic and benthic habitats. Geochemical data show that this ecologically flexible species can actively grow in both the seafloor sediments of a continental shelf or in surface waters of the open ocean far offshore. The existence of such a “tychopelagic” mode of life in foraminifers provides a glimpse at a possible mechanism by which planktic lineages may have evolved multiple times from benthic ancestors since Jurassic time.

The foray into the pelagic realm by benthic foraminifers is likely to have occurred a number of times over the past 180 myr. Times of high global sea level and flooded continental interiors correspond with numerous suspected invasions of the plankton by a number of different benthics. Some of these suspected experiments may have been initiated by a dynamic food supply or oxygen stress in the benthos. A number of unusual planktics existed in epicontinental seas or had restricted geographic distributions along continental margins, such as *Bifarina, Tenuitella insolita*, *Rectoguembelina, Zeauvigerina*, and *Anarcticella*. Others like *Heterohelix* (and their descendents), *Guembelitria*, *Tenuitella*, *Cassigerinella chipolensis,* and *Streptochilus* became very successful in the pelagic realm, with some more common and widespread than others. Fluctuating sea level and changing conditions of the OMZ are two of many factors that may have provided opportunities for benthic forams to make the leap into the plankton. Changing phytoplankton community structure of the upper water column, including the diversification and rise in dominance of dinoflagellates and coccolithophorids during the Mesozoic Era, and diatoms during the Cenozoic, may have also facilitated planktic foraminiferal evolution by stimulating experimental forays into the photic zone of the upper water column.