The response of foraminifera to modern seawater acidification: A real-time proxy for Paleogene hypothermal events

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The seas around the island of Ischia (Italy) have a variable and, on average, lowered pH as a result of volcanic gas vents that emit carbon dioxide from the sea floor at ambient seawater temperatures. These areas of acidified seawater provide natural laboratories in which to study the long-term biological response to rising CO_2 levels. Benthic foraminifera are routinely used to interpret the effects of climate change as they have short life histories, are environmentally sensitive and have an excellent fossil record. Here, we examined changes in foraminiferal assemblages along gradients in pH at CO_2 vents on the coast of Ischia as they may provide a useful model on which to base future predictions of the consequences of ocean acidification (Dias *et al*., 2010). We show that foraminiferal abundance, diversity and ability to calcify decreased markedly in living and dead assemblages as pH decreases, the result of CO_2 percolating through the seawater. Recent work by de Nooijer *et al*. (2009) has shown that foraminifera increase their internal pH to ~9.0 in the area of chamber calcification. If the ambient pH in the enclosing seawater is reduced to 7.8 (or below) the foraminifera with calcareous tests appear to be unable to complete the test construction process. These results are in accord with the responses recorded by coralline algae, corals, molluscs, barnacles and echinoderms at the same sites (Hall-Spencer *et al*., 2008).

Samples from the normal (pH8.17) environments around Ischia contain a diverse fauna dominated by miliolid foraminifera (e.g., *Peneroplis planatus*, *P. pertusus*, *Quinqueloculina* spp.) while those from areas with reduced pH (7.8 to 7.6) have faunas that are progressively less diverse and composed of <100% agglutinated taxa (e.g., *Ammoglobigerina globigeriniformis*, *Miliammina fusca*, *Trochammina inflata*, *Textularia* sp. cf. *T. bocki*). The changes in the benthic foraminifera are quite dramatic for only a slight reduction in pH and confirm the possibility that events, such as the PETM, could quite easily record a widespread loss of diversity or extinction as a result of ocean acidification.

Work on Ischia is on-going and there is a comparable site being investigated in the Gulf of California. A site on the south-east coast of the island of Vulcano (Mediterranean Sea) is also being considered.

References:

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