Living on the edge: physiological compensation for environmental acidification is limited in the deep-sea urchin *Allocentrotus fragilis*

Josi R. Taylor, Kurt R. Buck, Patrick J. Whaling, Christopher Lovera, Eric F. Pane and James P. Barry
Monterey Bay Aquarium Research Institute, Moss Landing, CA, USA

Anthropogenic CO_2 is now reaching depths over 1000m in the Eastern Pacific, overlapping with the Oxygen Minimum Zone (OMZ). Deep-sea animals living in this energy-limited environment have evolved in relatively stable biochemical conditions, and are subject to minimal diel and seasonal changes in water chemistry, compared to shallower marine ecosystems. Thus, deep-sea animals are suspected to be especially sensitive to environmental acidification associated with global climate change. We are investigating the effects of hypercapnia and hypoxia on the deep-sea urchin *Allocentrotus fragilis*, both in situ and during laboratory-based chronic exposure to pH 8.0, 7.5, 7.0, and 6.5. Collaboration between MBARI engineers and scientists, headed by Jim Barry, has led to development of a Benthic Respirometer System (BRS). The BRS allows repeated measurements of in situ O_2 consumption over several weeks, while conditions within eight experimental chambers are controlled by injection of CO_2- or O_2-saturated seawater. Preliminary results suggest urchin metabolism is more affected by O_2 availability than environmental CO_2. In the lab, a month-long investigation of blood acid-base chemistry at four levels of CO_2 shows *A. fragilis* has limited physiological ability to compensate for the systemic acidosis brought on by environmental acidification, due in part to low blood buffering capacity.