MEETING

Understanding Marine Biotic Responses to Fossil Fuel Emissions

ESF EuroCLIMATE Workshop: Atmospheric CO_2, Ocean Acidification, and Ecological Changes in Planktonic Calcifying Organisms; Barcelona, Spain, 26–28 September 2007

PAGE 127

Ocean acidification (OA) is increasingly recognized as an additional effect of rising carbon dioxide (CO_2) levels. To study this, a workshop, funded by the European Science Foundation EuroCLIMATE Programme and the Past Global Changes (PAGES) project, brought together a range of experts to review knowledge of the likely effects of OA on planktonic calcifying organisms and marine biogeochemistry in the upper ocean and to prioritize research for the near future.

The 45 participants reviewed research on four core-topic sessions: (1) Biocalcification mechanisms and their vulnerability to OA; (2) Genetics and physiology: Investigating organismal responses to OA; (3) Ecology and biogeography: Predicting the effects of population responses to OA; and (4) Lessons from the fossil record: Past responses to OA. Results and discussion will be published; a detailed report is available at http://www.esf.org/acidification-workshop/venue.html and http://the-eggs.org/articles.php?id=112.

We are beginning to understand why the physiology and the biocalcification of calcifying organisms are affected by high CO_2. In light of our new understanding, the risks of the projected magnitude of OA appear even larger than previously thought. Workshop attendees presented strong evidence that calcification by planktonic foraminifera and pteropods is sensitive to even slight oceanic pH changes. The results from coccolithophores are more ambiguous, but far from reassuring. Overall, data from present and past strongly suggest that projected levels of OA are likely to have a major effect on planktonic calcification and an impact on the marine organic carbon pump via reduced ballasting of marine snow.

A need was identified during the workshop for coordinated field observational, reconstructional, and process studies investigating OA impacts. This is challenging, with improved protocols needed for calcification rate measurements, CO_2 system parameterization, manipulation of seawater CO_2 chemistry, determination of abundances and distributions of planktonic calcifiers, and respiration measurements. Given the major socioeconomic consequences of OA, it is timely to join forces and share resources, guided by a steering group similar to that assembled from prior successful programs, such as the Joint Global Ocean Flux Study (JGOFS) and the World Ocean Circulation Experiment (WOCE).

An additional session addressed the likely impact of anthropogenic CO_2 and OA in Mediterranean ecosystems. Participants shared unpublished results showing recent large changes in the density-driven thermohaline circulation, which influences the uptake of anthropogenic carbon and thus seawater carbonate parameters, as well as evidence of organismal response to the observed changes. Because the Mediterranean Sea is a known sink for anthropogenic carbon, the environmental impacts of OA and temperature increase may be larger than in any other European region and should therefore be a primary research target.

The science reviewed at the workshop clearly showed that OA is liable to profoundly affect marine ecosystems and exacerbate the impact of rising CO_2 concentrations. Current knowledge, however, inadequately defines the threshold levels of CO_2 at which OA effects will cause major environmental impacts. Thus, there is a need for the scientific community to undertake research to identify the tipping point at which the detrimental effects of OA can no longer be forestalled.

—PATRIZIA ZIVERI, Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, Spain; also at Vrije Universiteit, Amsterdam, Netherlands; E-mail: Patrizia.Ziveri@uab.es; JEREMY YOUNG, Natural History Museum, London; VICTORIA FABRY, California State University San Marcos; JELLE BIJMA, Alfred-Wegener Institut für Polar- und Meeresforschung, Bremerhaven, Germany; DANIELA TURK, European Science Foundation, Strasbourg, France; THORSTEN KIEFER, PAGES International Project Office, Bern; and TONY EISENHAUER, Leibniz Institute of Marine Sciences at University of Kiel (IFM-GEOMAR), Germany