Progress in Controlled In Situ Ocean Acidification Experiments

FOCE Systems: Present Status and Future Developments; Villefranche-sur-Mer, France, 10-12 December 2012

Ocean acidification is widely recognized as a significant impact of global oceanic carbon cycle transport, not only independently but also in connection with other oceanic stressors, including warming and deoxygenation. Recent work shows that ocean acidification will negatively affect processes such as calcification of most spe-
cies, including reef-building corals, and could also compromise coral recovery ability and respiratory stress. However, almost all of these findings result from short-term experiments on isolated samples or in the laboratory. How can scientists perform long-term in situ experiments that may confirm, or modify, conclusions from laboratory experiments? With funding from the RFN Banward Foundation, the authors established a network of FOCE systems across 20 groups of 20 scientists and engineers to examine this.

xFOCE is an open source technology platform designed to make Free Ocean CO2 Enrichment (FOCE) systems adaptable. FOCE technology is used to study the effects of enrichment on marine organisms and communities through precise control of acidity (pH) within in situ experiments. The system incorporates a range of land-based scientists executing field experiments in natural environments with high carbonate dioxide (CO2) levels. The ocean ac-
cidification is most challenging in the lagoon of Saipan, with its slow reaction rates. This means that fully “open” systems (systems that interact continuously with their environments) are the best option for understanding the physiology of organisms and the processes occurring in systems with high carbonate dioxide (CO2). The ocean ac-
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F. Malback (Laboratoire d’Océanographie de Villefranche; Villefranche-sur-Mer, France) reviewed progress in deployment of the first Mediterranean Sea FOCE system (gFOCE, Villefranche-sur-Mer, France), which has made advances in cost reduction and user-friendly components while retaining essential controls. Advanced planning for an underwater FOCE experiment (apFOCE, Casey Station, Antartica) was described by D. Roberts (Uni-
versity of Tasmania, Australia). Carbonate ion concen-
trations are naturally so low there that seawater is close to the point of being corrosive for aragonite, with greatly significant biological consequences. W. Kirkwood described the next generation of systems, which have components and sensors that are easier for divers to exchange. The control software and engine-
ning specifications (iFOCE) are to be fully developed in 2013.

The participants welcomed the well-defined open source engineering principles and the successful initial field experiments. Experiments on key shallow-water systems will follow shortly after this meeting. Additional projects and additional information can be found at: http://www.foce.org.

P. Brixen (Montary Bay Aquarium Research Institute, MBARI, Moss Landing, Calif.; awkward@MBARI.edu) showed a stack of Killian Park, Orienta, E. Coene (Muséum National d’Histoire Naturelle, Paris, France; and J. Förster (Lancaster University, Department of Oceanography, Lancaster, U.K.) provided more details on how developing China’s National Oceanography Centre (NOC), Underwater Research Institute (UORI), and Shandong Oceanography Institute (SOI), all funded by the Chinese National Natural Science Foundation (NSFC). The project is expected to be completed in 2014.

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