

Experimental Study of Impact of Ocean Acidification on Marine Calcifier

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[Abstract]

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In this project, institutes having coastal experimental facilities participated for CO₂ manipulation experiments to investigate sensitive marine organisms for CO₂ acidification under elevated CO₂ level. The newly designed CO₂ controlling devices (AICAL system) were installed in all the participated laboratories. The accuracy of AICAL system was confirmed with several experiments under diverse of the operating conditions and with theoretical consideration. It is believed that early life stages of marine organisms are vulnerable to environmental stresses compared to adults. In this study, larvae of snails, sea urchin and corals have been examined with relatively low level of CO₂ exposure, which is strictly controlled by the AICAL system. Manipulation experiment under elevated CO₂ concentration of seawater for larvae of abalone revealed the significant impact above 1200 or 1500 ppm of CO₂. The edge of shells was deteriorated with higher concentration than the aragonite saturation level of carbonate ion in seawater, which is acceptable for chemical equilibrium of CaCO₃. The Japanese turbo showed similar response to high CO₂ level, however, squid larvae did not show serious impact of CO₂ even more than 1500 ppm. Growth of sea urchin larvae and coral primary polyp increased under low pCO₂ condition simulating the environment of the pre-industrial era. It suggests that calcification of larvae and juveniles of calcifiers may have been already stressed by the present atmospheric CO₂ level. The observed results for source waters in participating maritime laboratories were summarized and the annual and diurnal variability of coastal seawater was examined. The amplitude of Yokosuka and Shirahama laboratories was relatively large and around 200 to 300 ppm in summer season as the monthly average of daily maximum minus minimum, however the amplitude at Sesoko located in coral reef area was very small. We applied the possible range of observed CO₂ diurnal amplitude for the CO₂ manipulation experiment. Experiments for larvae of snail and sea urchin both indicated that the daily maximum CO₂ concentration in seawater exerted larger impact than the diurnal average concentration. It suggests that the manipulation experiment near future CO₂ environment of coastal area needs careful set up of CO₂ concentration considering diurnal and also seasonal change of seawater pCO₂.