Supplementary Information

I. B. Kuffner, A. J. Andersson, P. L. Jokiel, K. S. Rodgers, F. T. Mackenzie

Methods details

The mineralogy of the crustose coralline algae (CCA) scraped from the cylinders was analyzed by X-Ray Diffraction (XRD) using pure CaF_2 as reference material (Table 2). The analysis was conducted using a Scintag PAD V powder X-ray diffractometer at the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii, Honolulu. The X-ray source was a copper anode tube emitting X-rays at 1.540562 Å for kα_1. The detector was a solid state Ge detector. The Mg-calcite composition was calculated based on the relationship between d-spacing and magnesium content derived by Ref. [1].

Temperature and salinity were measured in each mesocosm using a YSI 30 salinity/conductivity/temperature meter ($\pm$ 0.1°C; $\pm$ 0.1 ppt). Dissolved oxygen was measured using YSI 95 Dissolved Oxygen Microelectrode Array Model ($\pm$ 0.2 mg L^{-1}). The pH of each mesocosm was measured using an Accumet AP72 handheld pH/mV/temperature meter ($\pm$ 0.01 pH units) with a fully enclosed Oakton Ag/AgCl combination electrode. The electrode was standardized in freshwater buffer solutions 4.00 and 7.00 from Fisher Scientific. Water samples for total alkalinity (TA) were collected at the surface of each mesocosm using 200-ml Kimax-brand glass sample bottles and poisoned with a saturated solution of mercuric chloride ($HgCl_2$; 100μL). Each bottleneck was taped with teflon tape prior to sampling to assure a tight seal and prevent atmospheric equilibration of gases. TA was determined by potentiometric acid titrations according to the procedure outlined in Ref. [2] using ~0.1N HCl with an ionic strength of ~0.7 [3]. The acid was standardized against certified reference material (CRM) prepared by Andrew

Dickson at Scripps Institution of Oceanography. CRMs were continuously analyzed at least every 10 samples to ensure accuracy and precision of the titration system. The 1σ precision of the TA analysis was 0.16% (~3.6 μmol kg^{-1}; n=27). Dissolved inorganic carbon samples were collected in a similar manner as TA and analyzed using an infrared DIC analyzer employing a Li-Cor 6262 NDIR as the detector. Regrettably, the DIC samples had obvious storage problems and were rendered useless. As a consequence, the CO_2-system parameters were calculated at *in-situ* temperature and salinity from TA and pH, rather than from TA and DIC. We used the program CO2SYS[4] employing stoichiometric carbonic acid system constants calculated on the NBS scale by Ref. [5] based on the constants defined by Ref. [6]. We recognize that these measurements are not ideal in order to calculate the total DIC system of seawater, owing to the relatively poor precision of the pH measurements and the fact that the pH electrode was standardized in freshwater buffers. Nevertheless, because the calculated pCO$_2$ of the control mesocosms was consistently in agreement with that measured for surface seawater by the NOAA PMEL buoy (http://www.pmel.noaa.gov/co2/coastal/kbay/157w_all.htm) located approximately 500 m from the seawater-intake line of the experimental mesocosms (Fig. 1a, black dots), we have little reason to suspect the validity of the data. Furthermore, the errors associated with the precision of the pH measurements and TA analyses were propagated through the calculations of the DIC parameters, and were negligible relative to the random error among mesocosms within the same treatment. Mesocosm seawater saturation state with respect to the average Mg-calcite composition of the crustose coralline algae (CCA) in the present experiment was calculated based on the biogenic "best fit" solubility curve determined from stoichiometric saturation[7,8] (K_{sp}=8.21) and using ion activity coefficients from Ref. [9]. Tables 2, 3 and 4 contain the tabulated data shown in Figs. 1 and 2, and selected additional data (e.g., temperature, salinity).

References

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