Event log for TI-668, May 2013 from R/V Tioga TI668 in the Wilkinson Basin, Gulf of Maine (GoME OA Pteropods project)

Website: https://www.bco-dmo.org/dataset/472324
Version: 2013-12-20

Project
» Acidification of the Coastal Ocean: Are deep waters of the Gulf of Maine already corrosive to pteropods? (GoME OA Pteropods)

Contributors	Affiliation	Role
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Dataset Description

DMO NOTE: 12/20/2013: Revised eventlog submitted and served: GPS was not functioning properly. Positions were matched to alongtrack via date/time. Replaces version 2013-11-20.

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Data Files

File
TI668_eventlog.csv (Comma Separated Values (.csv), 2.72 KB) MD5:8e6877e541f2c8430ac486332485a368 Primary data file for dataset ID 472324

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Parameters

Parameter	Description	Units
event	event or sampling operation number	
inst	Instrument used to collect data, see: instrument list	
cast	cast number	
station	consecutive station number	
day_local	day of month, local time	
month_local	month of year, local time	
time_local	time of day, local time, using 2400 clock format	
se_flag	sampling operation start (s) or end (e) flag	
lat	latitude, negative = South	
lon	longitude, negative = West	
depth_w	depth of water	meters
depth	depth of sample	meters
comments	free text comments	
lon_corr	corrected longitude value	decimal degrees
year	year	
lat_corr	latitude, corrected to agree with alongtrack data.	decimal degrees
timediff	The number of hours added to local time to convert to UTC.	hours
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted. This standard is based on ISO 8601:2004(E). e.g. 2009-08-30T14:05:00[.xx]Z (UTC time)	YYYY-MM-DDTHH:MM:SS[.xx]Z

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Deployments

TI668

Website	https://www.bco-dmo.org/deployment/59095
Platform	R/V Tioga
Report	http://bcodata.whoi.edu/GoME_Pteropods/cruise_reports/Tioga668_Cruise_Report_final_Dec.pdf
Start Date	2013-05-21
End Date	2013-05-22
Description	The central goal of this cruise was to sample the carbonate chemistry profile of two sites in the GoME and to document the abundance and vertical distribution of the pteropod species Limacina retroversa. The long-term goal of this research is to understand forcings by climate, enhanced atmospheric CO2 levels, and coastal eutrophication on seasonal and inter-annual variability in carbonate chemistry of the Gulf of Maine and the associated implications to planktonic calcifiers, notably pteropods. The specific goals of this project are to: 1. Quantify seasonal variations of carbonate system parameters and buffer intensity in deep waters of the Gulf of Maine in order to evaluate the sensitivity of these waters in response to acidification due to anthropogenic forcing, such as increase in atmospheric CO2, freshening of the GoME (decrease in total alkalinity) and increases in water-column respiration due to eutrophication. We will test the hypotheses that deep waters of the GoME are already seasonally under-saturated with respect to aragonite saturation state, and that these waters have low buffer intensity compared to overlying water, which would cause them to be more susceptible to acidification pressures and to reach critical ecological thresholds (OA < 1) more readily. 2. Quantify seasonal patterns in the abundance of the pteropod Limacina retroversa and its vertical distribution relative to concurrent measurements of water column chemical properties, testing the hypothesis that this species is absent in the acidic waters of the near-bottom nepheloid layer. The specific goals of this particular cruise were to: 1. Measure the carbonate chemistry of the water column at multiple sites in the Gulf of Maine, targeting regions where there the depth is greatest and the deep waters are mostly likely to be undersaturated 2. Measure the carbonate chemistry in the nephloid layer 3. Catch pteropods with a vertically stratified net system to quantify their size class, abundance and vertical distribution in the context of the carbonate chemistry. 4. Collect surface water and pteropods to test out methods for shell (70% ethanol), physiology (live) and gene expression studies (RNAlater). DMO NOTE: Revised cruise report with updated eventlog submitted 20 Dec. 2013.

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Project Information

Acidification of the Coastal Ocean: Are deep waters of the Gulf of Maine already corrosive to pteropods? (GoME OA Pteropods)

Coverage: Gulf of Maine

ABSTRACT
As a result of increases in atmospheric carbon dioxide (CO2), the ocean is taking up extra CO2 and becoming more acidic, in a process referred to as ocean acidification (OA). Certain coastal regions, such as the upwelling system along the U.S. West Coast, are more susceptible to the effects of ocean acidification than others, because their waters are naturally low in pH and saturation of aragonite (a calcium carbonate mineral), but higher CO2 concentration, at least at some times of year. In such OA 'hot-spots', continued anthropogenic perturbations to the carbonate chemistry will quickly push the system towards a more corrosive (aragonite under-saturated, OA < 1) environment that many calcium carbonate shell-forming organisms may not tolerate. Coastal acidification in the Gulf of Maine (GoME) has generally not been considered to be a pressing concern, but new data collected by our group and collaborators suggest that in the deep waters of the GoME low seawater pH may cause aragonite saturation states (OA) to be close to a chemical and ecological threshold (i.e. OA = 1). Currently, there are no year-round CO2 system measurements to assess conclusively whether the deep waters in the GoME are already experiencing seasonal OA under-saturation. If seasonal undersaturation is present, however, this may have detrimental consequences to thecosome pteropods, a group of aragonite shell-forming zooplankton that are important members of the pelagic food web and key contributors to

biogeochemical cycles.

We propose an interdisciplinary project aiming to assess seasonal variations of the CO2 system in the deep GoME and the associated impacts on thecosome pteropods. The main objectives of this project are to: (1) investigate if deep waters of the GoME are already seasonally under-saturated with respect to aragonite saturation state, and if these waters are more susceptible to acidification pressures; (2) quantify seasonal patterns in the abundance of the most common thecosome pteropod in the GoME, Limacina retroversa, and examine the impacts of potential under-saturation of aragonite on its vertical distribution; (3) investigate the physiological response of the animal to its chemical environment. Demonstration that the deep waters of the GoME are already seasonally undersaturated with respect to aragonite would be an important development. If the GoME does indeed qualify as a coastal acidification 'hot spot,' the proposed study would undoubtedly have significant implications for future funding of coastal acidification research in the GoME.

OBJECTIVES

The long-term goal of this research is to understand forcing by climate, enhanced atmospheric CO2 levels, and coastal eutrophication, on seasonal and inter-annual variability in carbonate chemistry of the Gulf of Maine and the associated implications to planktonic calcifiers, notably pteropods. The specific goals of this project are to:

1. Quantify seasonal variations of carbonate system parameters and buffer intensity in deep waters of the Gulf of Maine in order to evaluate the sensitivity of these waters in response to acidification due to anthropogenic forcing, such as increase in atmospheric CO2, freshening of the GoME (decrease in total alkalinity) and increases in water-column respiration due to eutrophication. We will test the hypotheses that deep waters of the GoME are already seasonally under-saturated with respect to aragonite saturation state, and that these waters have low buffer intensity compared to overlying water, which would cause them to be more susceptible to acidification pressures and to reach critical ecological thresholds (OA < 1) more readily.

2. Quantify seasonal patterns in the abundance of the pteropod Limacina retroversa and its vertical distribution relative to concurrent measurements of water column chemical properties, testing the hypothesis that this species is absent in the acidic waters of the near-bottom nepheloid layer.

3. Measure variations in L retroversa metabolic rate as a function of local microenvironments of the Gulf of Maine, controlling temperature and carbonate chemistry in the lab to recreate conditions naturally experienced by the pteropods at shallow and deep depths in the water column, testing whether there is a physiological response of the animals to their chemical environment.

PROPOSED RESEARCH

We propose three 2-day research cruises on the R/V Tioga to the deep portions of Wilkinson Basin (~300m) in the GoME, targeting the time periods of late spring/early summer, late summer/early fall, and late fall/early winter when aragonite under-saturation is most likely. During each cruise, full water-column CTD casts will be taken at two or more stations near the deepest part of the basin, along with in-situ measurements of O2 and particle backscatter (to identify the bottom nepheloid layer). We will make bottle measurements of DIC, TA, and pH. This will allow us to fully define the seawater CO2 system for calculation of OA and various buffer factors (Egleston et al. 2010), which characterize the sensitivity of seawater against changes in acidity (pH), and OA under acidification. Underway measurements of pCO2, DIC, pH, fluorescence, and CTD will also be made along the cruise track to identify productive waters.

At each station, pteropods will be sampled with a ¼-m2 Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) with six 150-µm mesh nets. MOCNESS tows will be performed immediately after CTD casts and will target depth layers chosen based on examination of the CTD's dissolved oxygen, and transmissometry data as indices of chemical conditions, such that some nets will sample exclusively within the nepheloid layer, as well as at shallower intervals. A subset of captured pteropods will be picked out of the samples and transported alive in 1-L jars to WHOI. The remainder of each sample will be preserved in 95% ethanol for later quantification of abundance and size.

Profiles will be made with a Video Plankton Recorder to further quantify pteropod abundance and vertical distribution, and to quantify particle abundance for our collaborator C. Pilskaln. Prof. Pilskaln or one of her graduate students will participate in the cruises at no-cost to this project, and will collect large-volume (5-10 L) filtered particle samples from Niskin bottles triggered in the nearbottom particle resuspension (i.e., nepheloid) layer. Prof. Pilskaln's measurements will thus target the particulate fraction and help constrain the overall water column carbonate budget. Water will also be collected for use in later metabolic lab studies.

Pteropods transported to WHOI will be used in laboratory studies of acute metabolic effects of high CO2/low

pH. After an 8 hour acclimation period to clear their guts, individual animals will be exposed in respiration chambers for 48 hours to conditions recreating the temperature and carbonate chemistry of deep and shallow portions of the water column (created starting with water collected at the point of capture). Rates of respiration and ammonia excretion in manipulated and control animals will be measured following standard techniques (see Maas et al., 2012).

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Funding

Funding Source	Award
WHOI (WHOI - internal)	COI-2012: Wang,Lawson,Maas

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