Suspended calcite, calcification and photosynthesis from R/V Thomas G. Thompson TT049, TT053 cruises in the Arabian Sea in 1995 (U.S. JGOFS Arabian Sea project)

Website: https://www.bco-dmo.org/dataset/2557
Version: final
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Project
» U.S. JGOFS Arabian Sea (Arabian Sea)

Program
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

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Methods & Sampling

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Calcification and Photosynthesis Measurements from 12$_o$ N to 12$_o$ S along 140$_o$ W

William M. Balch

Goal: To measure rates of calcification during the EqPac survey cruise from 12$_o$ N to 12$_o$ S along 140$_o$ W. We will be estimating calcification and photosynthesis using a ^{14}C technique, as well as standing stock of calcite using a light scatter technique.

Participants: Survey No. 2: William M. Balch, Katherine Kilpatrick

Measurements, protocols and QA/QC:

^{14}C stock preparation: The ^{14}C-bicarbonate stock solution will be cleaned by acidification with sulfuric acid to drive off the CO_2 into the headspace of an enclosed glass vessel and the headspace gas recirculated through 1 ml of 1 *N* NaOH to collect the ^{14}. The 1 ml of NaOH will be subsequently diluted with Milli-Q water to a final activity of about 1 mCi per ml, 0.2 mm filter sterilized and stored in acid cleaned, sterile, glass vials with teflon screw caps. The stock will be removed with sterile, acid-cleaned, plastic micropipetters (not metal syringe needles). Addition of this alkaline stock to seawater at the levels we will be using changes the pH of the seawater by less than 0.01 pH units.

Bottle preparation: All incubations will be done in 250 ml polycarbonate bottles. The bottles will have been soaked for 5 days in warm Alconox detergent solution (to avoid the ammonium contamination found in Micro detergent), rinsed 3 times and soaked over night with deionized water, rinsed once with Milli-Q water, then soaked 3 days in 20 % HCl solution, and rinsed 5 times in Milli-Q water. At sea, used bottles will be rinsed with isotope free filtered sea water, rinsed once with Milli-Q water and 90 ethanol to kill any bacterial/algal films adhering to the bottle walls, followed by a 10 % HCl rinse, then 3 rinses with Milli-Q water.

Sampling protocol: Samples will be drawn from Niskin bottles before sunrise, and transferred to the 250 polycarbonate bottles (and kept in darkness). 20 mCi of ^{14}C-bicarbonate stock will be added to each bottle from the 10 depth cast, and the bottles will be either placed in the deck incubator or put in large mesh bags to be attached to the *in situ* arrays, then deployed. Samples will be incubated for 24 hours, after which the contents of each bottle will be split into two 100 ml aliquots, and filtered onto 0.4 mm nuclepore filters (these filters are required to maintain low interstitial water content, hence low background ^{14}C activity). Each replicate filter will be fumed for 3 minutes in a desicator containing concentrated HCl to drive off activity due to calcite. Filters will then be placed in a scintillation cocktail, and radioactivity measured in a liquid scintillation counter on board the ship. Calcification rates are calculated based on the difference between the unfumed filter counts and the fumed filter counts.

QA/QC: We will check our photosynthesis numbers against R. T. Barber's for internal consistancy, especially since different types of filters must be used. We will also check by filtering our own samples with the various filter types. Trace metal contamination will be checked by adding EDTA to a separate ^{14}C incubation bottle and comparing this to the untreated control. A check on loss of organic material following fuming has been performed by incubating non-calcifying coccolithophore clones with ^{14}C, and fuming as described above. When the filter activities were subtracted, the difference was zero, not a negative value, which demonstrates that no organic carbon is lost in the fuming procedure.

Calcite standing stock measurements: The abundance of calcium carbonate coccoliths can be estimated continuously using an optical technique. Water is diverted from the autoanalyzer flow stream and run through a glass cuvette in front of a laser beam (660 nm light). Light scatter at 90^o is measured with a photodiode, and this value will be recorded using a data logging system. Every 5 minutes, the stream passing the laser will be diluted with glacial acetic acid to drop the pH to 6, and dissolve calcium carbonate, and the 90^o scatter will be measured again. The difference in the scatter values represents the 90^o light scatter due to the acid labile fraction. This has been shown to be highly correlated to the standing stock of coccoliths (see Balch *et al.*, 1991; *Limnology and Oceanography*; **36**: 629--643). These measurements will be run during transects and vertical profiles.

QA/QC: The standing stock estimates will be calibrated using microscope counts made on the ship, as well as counts from samples preserved with Lugols solution. The microscope we use has polarization optics which allow the birefringent coccoliths to be easily counted (and any other calcium carbonate particles for that matter).

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Parameters

Parameter	Description	Units
event	event number from event log	
sta_std	Arabian Sea standard station identifier	
sta	station number from event log	
cast	CTD rosette cast number from event log	
bot	CTD rosette bottle number	
depth	sample depth	meters
Ca_p	Calcium concentration for any particles greater than 0.4 microns; effectively the suspended calcite concentration.	micrograms/liter
C_photosyn	Photosynthesis: rate of C-14 fixation (organic fraction) by micro-diffusion method.	micrograms C/liter/day
C_calcif	Calcification: rate of C-14 fixation (calcite fraction) by micro-diffusion method.	micrograms C/liter/day

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Instruments

Dataset-specific Instrument Name	Niskin Bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Niskin bottles are used to collect water samples.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

TT049

Website	https://www.bco-dmo.org/deployment/57710
Platform	R/V Thomas G. Thompson
Start Date	1995-07-17
End Date	1995-08-15
	Methods & Sampling PI: William Balch of: Bigelow Laboratory dataset: Suspended calcite, calcification and photosynthesis dates: July 18, 1995 to August 13, 1995 location: N: 22.516 S: 9.9964 W: 57.3012 E: 68.75 project/cruise: Arabian Sea/TTN-049 - Process Cruise 4 (Middle SW Monsoon) ship: Thomas Thompson PI Note: The photosynthesis and calcification technique was modified according to: Paasche, E. and S. Brubak. 1994. Enhanced calcification in the coccolithophorid

Description	Emiliania huxleyi (Haptophyceae) under phosphorus limitation. Phycologia 33: 324-330. DMO Note: Data are served with ascending event numbers. At stations 7, 13, 17, 22, 27, 29 and 30, the depth profile was taken in two casts, with the deep cast done first. At these stations, the depth will be out of order. Nuclepore 0.4 micron membrane filters were used for all filtrations. **Processing Description** Calcification and Photosynthesis Measurements from 12 N to 12 S along 140 W William M. Balch Goal: To measure rates of calcification during the EqPac survey cruise from 12 N to 12 S along 140 W. We will be estimating calcification and photosynthesis using a C technique, as well as standing stock of calcite using a light scatter technique. Participants: Survey No. 2: William M. Balch, Katherine Kilpatrick Measurements, protocols and QA/QC: C stock preparation: The C-bicarbonate stock solution will be cleaned by acidification with sulfuric acid to drive off the CO into the headspace of an enclosed glass vessel and the headspace gas recirculated through 1 ml of 1 N NaOH to collect the . The 1 ml of NaOH will be subsequently diluted with Milli-Q water to a final activity of about 1 mCi per ml, 0.2 mm filter sterilized and stored in acid cleaned, sterile, glass vials with teflon screw caps. The stock will be removed with sterile, acid-cleaned, plastic micropipetters (not metal syringe needles). Addition of this alkaline stock to seawater at the levels we will be using changes the pH of the seawater by less than 0.01 pH units. Bottle preparation: All incubations will be done in 250 ml polycarbonate bottles. The bottles will have been soaked for 5 days in warm Alconox detergent solution (to avoid the ammonium contamination found in Micro detergent), rinsed 3 times and soaked over night with deionized water, rinsed once with Milli-Q water, then soaked 3 days in 20 % HCl solution, and rinsed 5 times in Milli-Q water. At sea, used bottles will be rinsed with isotope free filtered sea water, rinsed once with Milli-Q water and 90 ethanol to kill any bacterial/algal films adhering to the bottle walls, followed by a 10 % HCl rinse, then 3 rinses with Milli-Q water. Sampling protocol: Samples will be drawn from Niskin bottles before sunrise, and transferred to the 250 polycarbonate bottles (and kept in darkness). 20 mCi of C-bicarbonate stock will be added to each bottle from the 10 depth cast, and the bottles will be either placed in the deck incubator or put in large mesh bags to be attached to the in situ arrays, then deployed. Samples will be incubated for 24 hours, after which the contents of each bottle will be split into two 100 ml aliquots, and filtered onto 0.4 mm nuclepore filters (these filters are required to maintain low interstitial water content, hence low background C activity). Each replicate filter will be fumed for 3 minutes in a desicator containing concentrated HCl to drive off activity due to calcite. Filters will then be placed in a scintillation cocktail, and radioactivity measured in a liquid scintillation counter on board the ship. Calcification rates are calculated based on the difference between the unfumed filter counts and the fumed filter counts. QA/QC: We will check our photosynthesis numbers against R. T. Barber's for internal consistancy, especially since different types of filters must be used. We will also check by filtering our own samples with the various filter types. Trace metal contamination will be checked by adding EDTA to a separate C incubation bottle and comparing this to the untreated control. A check on loss of organic material following fuming has been performed by incubating non-calcifying coccolithophore clones with C, and fuming as described above. When the filter activities were subtracted, the difference was zero, not a negative value, which demonstrates that no organic carbon is lost in the fuming procedure. Calcite standing stock measurements: The abundance of calcium carbonate coccoliths can be estimated continuously using an optical technique. Water is diverted from the autoanalyzer flow stream and run through a glass cuvette in front of a laser beam (660 nm light). Light scatter at 90 is measured with a photodiode, and this value will be recorded using a data logging system. 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TT053

Website	https://www.bco-dmo.org/deployment/57714

Platform	R/V Thomas G. Thompson
Start Date	1995-10-29
End Date	1995-11-26

Description	**Methods & Sampling** PI: William Balch of: Bigelow Laboratory dataset: Suspended calcite, calcification and photosynthesis dates: October 29, 1995 to November 23, 1995 location: N: 24.3302 S: 10.0823 W: 56.4971 E: 67.1664 project/cruise: Arabian Sea/TTN-053 - Process Cruise 6 (bio-optics) ship: Thomas Thompson PI Note: The photosynthesis and calcification technique was modified according to: Paasche, E. and S. Brubak. 1994. Enhanced calcification in the coccolithophorid Emiliania huxleyi (Haptophyceae) under phosphorus limitation. Phycologia 33: 324-330. Nuclepore 0.4 micron membrane filters were used for all filtrations. **Processing Description** Calcification and Photosynthesis Measurements from 12 N to 12 S along 140 W William M. Balch Goal: To measure rates of calcification during the EqPac survey cruise from 12 N to 12 S along 140 W. 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Project Information

U.S. JGOFS Arabian Sea (Arabian Sea)

Website: http://usjgofs.whoi.edu/research/arabian.html

Coverage: Arabian Sea

The U.S. Arabian Sea Expedition which began in September 1994 and ended in January 1996, had three major components: a U.S. JGOFS Process Study, supported by the National Science Foundation (NSF); Forced Upper Ocean Dynamics, an Office of Naval Research (ONR) initiative; and shipboard and aircraft measurements supported by the National Aeronautics and Space Administration (NASA). The Expedition consisted of 17 cruises aboard the R/V Thomas Thompson, year-long moored deployments of five instrumented surface buoys and five sediment-trap arrays, aircraft overflights and satellite observations. Of the seventeen ship cruises, six were allocated to repeat process survey cruises, four to SeaSoar mapping cruises, six to mooring and benthic work, and a single calibration cruise which was essentially conducted in transit to the Arabian Sea.

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Program Information

U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Website: http://usjgofs.whoi.edu/

Coverage: Global

The United States Joint Global Ocean Flux Study was a national component of international JGOFS and an integral part of global climate change research.

The U.S. launched the Joint Global Ocean Flux Study (JGOFS) in the late 1980s to study the ocean carbon cycle. An ambitious goal was set to understand the controls on the concentrations and fluxes of carbon and associated nutrients in the ocean. A new field of ocean biogeochemistry emerged with an emphasis on quality measurements of carbon system parameters and interdisciplinary field studies of the biological, chemical and physical process which control the ocean carbon cycle. As we studied ocean biogeochemistry, we learned that our simple views of carbon uptake and transport were severely limited, and a new "wave" of ocean science was born. U.S. JGOFS has been supported primarily by the U.S. National Science Foundation in collaboration with the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Energy and the Office of Naval Research. U.S. JGOFS, ended in 2005 with the conclusion of the Synthesis and Modeling Project (SMP).

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