Formaminiferal Flux acquired by the Santa Barbara Basin Sediment Trap Mooring between 2014 and 2021

Website: https://www.bco-dmo.org/dataset/936276
Data Type: Other Field Results
Version: 1
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Project
» Collaborative Research: Three decades of foraminiferal assemblages in the Santa Barbara Basin provide a link between present and past (planktic foram assemblages)

Contributors	Affiliation	Role
Davis, Catherine	North Carolina State University (NCSU)	Principal Investigator, Scientist
Benitez-Nelson, Claudia R.	University of South Carolina	Scientist
Havard, Emily	North Carolina State University (NCSU)	Scientist, Student, Technician, Data Manager
Cherry, Katherine	North Carolina State University (NCSU)	Technician
Tappa, Eric	University of South Carolina	Technician
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
The geologically rapid response of foraminiferal assemblages to changing climate makes their shells an invaluable geological record of the past. However, just how rapid these changes are is unknown and the specific drivers of assemblage composition and abundance are complex. Understanding how modern foraminifera respond to and record a climate event that would appear nearly instantaneous in the sediment record can inform paleontological interpretations and help to place foraminifera in a broader ecological context. We focus on the impact of ongoing, rapid climate change on planktic foraminifera in the California Current ecosystem. The Santa Barbara Basin sediment trap, located off the coast of California, USA since 1993, provides a 28-year record of particulate and foraminiferal flux to the basin. The sediment trap captures the superposition of the annual cycle of seasonal upwelling in Santa Barbara Basin, Pacific multiannual ENSO-driven temperature changes, and anthropogenically forced climate change. We present data on planktic foraminiferal flux collected between 2014-2021 from the Santa Barbara Basin sediment trap, at two-week intervals (164 samples). The dataset contains species-level planktic foraminiferal flux values from May 24, 2014 to November 11, 2021. The most abundant species from 2014-2021 were Globigerina bulloides, Neogloboquadrina incompta, and Turborotalita quinqueloba.

Table of Contents

Coverage

Location: Santa Barbara Basin, California, 34o 14' 42.14" N 120o 03' 33.45" W
Spatial Extent: **Lat**:34.245039 **Lon**:-120.059292
Temporal Extent: 2014-05-24 - 2021-11-11

Dataset Description

Similar datasets of planktic foraminiferal flux from the Santa Barbara Basin Sediment Trap: 1993-1996 (Kincaid et al., 2000) and 1995-1998 (Black et al., 2001). See related dataset section.

Methods & Sampling

Samples were collected at 10-to-14-day intervals by a moored sediment trap in Santa Barbara Basin, CA (34°14’42.14’’ N, 120°03’33.45’’ W) between May 24, 2014, and November 11, 2021. The sediment trap is a McLane Parflux 78H model. It has been located at > 400 m depth (the basin is ~589 m deep; Eichhubl et al., 2001) since 1993. Samples were preserved in a borate-buffered formalin solution and collected from the sediment trap every six months, excluding the periods between July-October 2015 and May-November 2020. After collection, samples were split into 16 parts. One 16th was used for foraminiferal flux and species counts. Each sample was wet picked for foraminifera following the procedure outlined in Kincaid et al. (2000). The formalin solution was rinsed out using tap water and a 125µm sieve, remaining consistent with previous SBB assemblage studies (Kincaid et al., 2000; Black et al., 2001). All foraminifera present in the sample were separated from other sediment trap material using a fine paint brush and allowed to air dry. Following wet picking, foraminifera were sorted by species and counted to determine foraminiferal flux and relative abundance.

Data Processing Description

Foraminiferal flux was calculated from species counts (1/16th splits) to determine the #foraminifera m-2 day-1 for each full sample. This method is consistent with the flux calculations used in Kincaid et al. (2000) and Black et al. (2001) for the same sediment trap with an area of 0.5 m2. Flux = (raw count*16)/(collection duration(days) * 0.5m2).

BCO-DMO Processing Description

* adjusted column names to comply with database requirements
* added sampling latitude and longitude to dataset
* converted dates to ISO format dates

Problem Description

There are two gaps in sampling. The first is due to an instrument malfunction from July-October 2015. The second is due to the COVID-19 pandemic from May-November 2020.

[table of contents | back to top]

Data Files

File
936276_v1_foramflux.csv (Comma Separated Values (.csv), 31.47 KB) MD5:054071e218d92b6e5c24f18d24f0ae44 Primary data file for dataset ID 936276, version 1

[table of contents | back to top]

Related Publications

Havard, E., Cherry, K., Benitez-Nelson, C., Tappa, E., and Davis, C.V.: Decreasing foraminiferal flux in response to ongoing climate change in the Santa Barbara Basin, California, in preparation for submission to Biogeosciences, 2024.
Results

[table of contents | back to top]

Related Datasets

IsRelatedTo

Black, D. E., Thunell, R. C., & Tappa, E. J. (2001). Planktonic foraminiferal response to the 1997–1998 El Niño: A sediment-trap record from the Santa Barbara Basin. Geology, 29(12), 1075. https://doi.org/10.1130/0091-7613(2001)029<1075:pfrtte>2.0.co;2 https://doi.org/10.1130/0091-7613(2001)029<1075:PFRTTE>2.0.CO;2

Kincaid, E., Thunell, R. C., Le, J., Lange, C. B., Weinheimer, A. L., & Reid, F. M. H. (2000). Planktonic foraminiferal fluxes in the Santa Barbara Basin: response to seasonal and interannual hydrographic changes. Deep Sea Research Part II: Topical Studies in Oceanography, 47(5–6), 1157–1176. https://doi.org/10.1016/s0967-0645(99)00140-x https://doi.org/10.1016/S0967-0645(99)00140-X

[table of contents | back to top]

Parameters

Parameter	Description	Units
Sediment_trap_deployment_ID	Sediment trap deployment ID	unitless
Cup_Sample_ID	Cup # (sample ID) within deployment	unitless
Latitude	Latitude of sediment trap location, south is negative	decimal degrees
Longitude	Longitude of sediment trap location, west is negative	decima degrees
Open	Open date of sample collection	unitless
Close	Close date of sample collection	unitless

Mid	Mid point date of sample collection, calculated from open and close date	unitless
Duration_days	Duration of sample collection (days)	days
FxG_bulloides	Foraminiferal flux G. bulloides, calculated from species counts	# of foraminifera m-2 d-1
FxN_incompta	Foraminiferal flux N. incompta, calculated from species counts	# of foraminifera m-2 d-1
FxT_quinqueloba	Foraminiferal flux T. quinqueloba, calculated from species counts	# of foraminifera m-2 d-1
FxN_pachyderma	Foraminiferal flux N. pachyderma, calculated from species counts	# of foraminifera m-2 d-1
FxG_glutinata	Foraminiferal flux G. glutinata, calculated from species counts	# of foraminifera m-2 d-1
FxG_siphonifera	Foraminiferal flux G. siphonifera, calculated from species counts	# of foraminifera m-2 d-1
FxH_pelagica	Foraminiferal flux H. peligica, calculated from species counts	# of foraminifera m-2 d-1
FxG_calida	Foraminiferal flux G. calida, calculated from species counts	# of foraminifera m-2 d-1
FxO_universa	Foraminiferal flux O. universa, calculated from species counts	# of foraminifera m-2 d-1
FxN_dutertrei	Foraminiferal flux N. dutertrei, calculated from species counts	# of foraminifera m-2 d-1
FxB_digitata	Foraminiferal flux B. digitata, calculated from species counts	# of foraminifera m-2 d-1
FxG_tenellus	Foraminiferal flux G. tenellus, calculated from species counts	# of foraminifera m-2 d-1
FxG_rubescens	Foraminiferal flux G. rubescens, calculated from species counts	# of foraminifera m-2 d-1

FxT_parkerae	Foraminiferal flux T. parkerae, calculated from species counts	# of foraminifera m-2 d-1
FxG_minuta_G_uvula	Foraminiferal flux G. minuta and G. uvula, calculated from species counts	# of foraminifera m-2 d-1
FxG_falconensis	Foraminiferal flux G. falconensis, calculated from species counts	# of foraminifera m-2 d-1
FxB_variabilis	Foraminiferal flux B. variabilis, calculated from species counts	# of foraminifera m-2 d-1
FxT_iota	Foraminiferal flux T. iota, calculated from species counts	# of foraminifera m-2 d-1
FxG_hexagonus	Foraminiferal flux G. hexagonus, calculated from species counts	# of foraminifera m-2 d-1
FxT_sacculifer	Foraminiferal flux T. sacculifer, calculated from species counts	# of foraminifera m-2 d-1
FxG_scitula	Foraminiferal flux G. scitula, calculated from species counts	# of foraminifera m-2 d-1
FxG_ruberalbus	Foraminiferal flux G. ruber albus, calculated from species counts	# of foraminifera m-2 d-1
FxG_inflata	Foraminiferal flux G. inflata, calculated from species counts	# of foraminifera m-2 d-1
FxG_hirsuta	Foraminiferal flux G. hirsuta, calculated from species counts	# of foraminifera m-2 d-1
FxG_truncatulinoides	Foraminiferal flux G. truncatulinoides, calculated from species counts	# of foraminifera m-2 d-1
FxG_ruberruber	Foraminiferal flux G. ruber ruber, calculated from species counts	# of foraminifera m-2 d-1
Fx_other	Flux values for unidentified or ambiguous foraminifera that were not speciated	# of foraminifera m-2 d-1
Flux_Total	Sum of columns foraminiferal flux data, presenting total foraminiferal flux	# of foraminifera m-2 d-1

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	McLane Parflux 78H sediment trap
Generic Instrument Name	Sediment Trap
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

[table of contents | back to top]

Project Information

Collaborative Research: Three decades of foraminiferal assemblages in the Santa Barbara Basin provide a link between present and past (planktic foram assemblages)

NSF Award Abstract:

Modern day releases of the greenhouse gas, carbon dioxide, into the atmosphere are the highest observed over the last 30 million years. This has resulted in major changes in the ocean. This work focuses on using a group of shell-forming organisms, planktic foraminifera. The carbonate shells of foraminifera are found in seafloor sediments. They provide a history of the environment in which they grew. The goal of this project is to use the shells of foraminifera to better understand how quickly and why the abundances of different foraminifera species change in response to climate. A thirty-year record of planktic foraminifera abundances will be created from stored samples collected from the Santa Barbara Basin, California. The results will be connected to modern day oceanographic measurements and the foraminifera found in older seafloor sediments. This will allow a better understanding of how climate change has impacted the ocean environment over very long time periods and allow future predictions. This project will provide hands on research training for students. Classroom activities will be developed that promote quantitative and data visualization skills with a real-world dataset.

Foraminifera have species-specific environmental preferences that influence their assemblages in the water column and in marine sediments. Moreover, the geochemistry of foraminiferal shells has become the foundation for widely used paleoceanographic proxies. However, interpretation of the fossil foraminiferal record must be fundamentally grounded in foraminiferal ecology. For example, use of geochemical proxies relies on the assumption of negligible change in seasonality or habitat through time, with violations potentially responsible for key errors in the paleoceanographic record. In addition to assessing rates and drivers of foraminiferal faunal change, this research would fulfill goals including: 1) testing how changing seasonality influences interpretations of foraminiferal-based proxy records, 2) evaluating whether sediment trap faunas are representative of underlying sediment, and 3) integrating 21st century foraminiferal faunal change with the geological record. Assemblages from biweekly sediment traps and near-annually resolved samples from a sediment core will be generated to accomplish these goals. Santa Barbara Basin was chosen because it has an archive of sediment trap material, extensive overlapping observational measurements, a well-preserved fossil record, and experiences climatic oscillations at timescales from seasonal to anthropogenic and longer. Quantitative assemblages will be supported by stable isotope and trace elemental analyses of a subset of shells to test interpretations of geochemical proxy records.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2223074

[table of contents | back to top]