One minute cruise tracks from KM0919, KM0920, and KN195-07 in the North Pacific Subtropical Gyre, Hawaiian Islands - Stations Kahe, ALOHA, Kena and WHOTS Mooring in 2009 (Silica Cycling project)

Website: https://www.bco-dmo.org/dataset/3881
Version: 28 February 2013
Version Date: 2013-02-28

Project
» Silica Cycling and the Role of Diatoms in the North Pacific Subtropical Gyre (Silica Cycling)

Contributors	Affiliation	Role
Brzezinski, Mark A.	University of California-Santa Barbara (UCSB)	Principal Investigator, Contact
Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Cruise Tracks for those Silica Cycling cruises with archived cruise track files at R2R
CruiseId, ISO_DateTime, Lat, Lon, SOG, COG

Methods & Sampling

Generated from R2R data files

Data Processing Description

Generated from R2R data files

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Data Files

File
CruiseTracks.csv (Comma Separated Values (.csv), 2.27 MB) MD5:ad64ddb6cacf2aefa4534ebe7aabb433 Primary data file for dataset ID 3881

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Parameters

Parameter	Description	Units
CruiseId	Official UNOLS Cruise Id	text
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted	YYYY-MM-DDTHH:MM:SS.xxxxZ
Latitude	Latitude Decimal format (South is negative)	decimal degrees
Longitude	Longitude Decimal format (West is negative)	decimal degrees
SOG	Speed Over Ground	meters/second
COG	Course Over Ground (degrees CW from N)	decimal degrees

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Deployments

KM0919

Website	https://www.bco-dmo.org/deployment/58874
Platform	R/V Kilo Moana
Start Date	2009-07-29
End Date	2009-08-14
Description	This cruise was funded by NSF OCE-0648130. Original cruise data are available from the NSF R2R data catalog.

KM0920

Website	https://www.bco-dmo.org/deployment/59014
Platform	R/V Kilo Moana
Report	http://hahana.soest.hawaii.edu/hot/cruises.html
Start Date	2009-08-17
End Date	2009-08-21
Description	HOT - Cruise Schedules, Chief Scientist Reports and Cast Sheets Cruise information and original data are available from the NSF R2R data catalog.

KN195-07

Website	https://www.bco-dmo.org/deployment/59010
Platform	R/V Knorr
Report	http://hahana.soest.hawaii.edu/hot/cruises.html
Start Date	2009-04-27
End Date	2009-05-01
Description	HOT - Cruise Schedules, Chief Scientist Reports and Cast Sheets

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Project Information

Silica Cycling and the Role of Diatoms in the North Pacific Subtropical Gyre (Silica Cycling)

Coverage: North Pacific Subtropical Gyre north of Hawaii, near (30 N, 140 W)

This study examines the unique silicon cycle of the North Pacific Subtropical Gyre (NPSG).

Most marine silicon cycle studies have focused on the more productive coastal waters or the Southern Ocean where diatoms typically dominate the phytoplankton. Although diatom biomass is much lower in subtropical gyres, silica production is significant in global terms. Silicon cycle studies of the Sargasso Sea in the 1990's implied that subtropical gyres account for 13% of global marine silica production. More recent data from the NPSG show much higher rates of silica production that would increase the contribution of subtropical gyres to as much as 40%. The new estimate is uncertain and based on few data, but suggests that the contribution of subtropical gyres has been underestimated. Differences in the silicon cycle between the NPSG and the Sargasso Sea go beyond differences in average production rates. The two systems are several months out of phase with each other in terms of their seasonal silica production cycles. Unlike the Sargasso Sea, where diatoms bloom regularly in spring in response to winter convective overturn, permanent stratification prevents spring diatom blooms events in the NPSG, where annual diatom blooms occur in summer, when stratification is strongest and nutrient concentrations are at a seasonal minimum. These enigmatic summer blooms contribute significantly to carbon and nitrogen export in the NPSG and likely dominate the annual silicon cycle.

Time series of rate measurements will be made in collaboration with the HOT program to define the annual silicon cycle at station ALOHA. The project will also collaborate with the new "Center for Microbial Oceanography: Research and Education" (CMORE) Science and Technology Center at the University of Hawaii to study summer blooms. Funding for this portion of the project is from NSF OCE-0648130.

Separately funded laboratory studies (NSF OCE-0726726; Title: Biological characterization of the nitrogen-fixing Rhizosolenia-Richelia symbiosis), looked at the role of diatom-diazotroph associations (DDAs) in elemental cycling in the NPSG.

Nitrogen-fixation provides a key input of new nitrogen into oligotrophic, oceanic regions. Work over the past two decades has highlighted the role of Trichodesmium. More recently, the role of coccoid cyanobacteria as well as symbiotic associations of the filamentous cyanobacteria Richelia intracellularis with species of diatoms (Rhizosolenia and Hemiaulus) has received attention. Little is known of the growth rates, nutrient needs, chemical composition, or environmental tolerances of these DDAs. However, it is clear that DDAs are numerically important in some oceans and can play a major role in mediating new nitrogen inputs. Recent models have identified the need for species-specific parameters, but these are lacking for DDAs. In particular, temperature dependent properties require quantification for application to global warming scenarios.

Laboratory studies of both the Rhizosolenia-Richelia and Hemiaulus-Richelia DDA are now possible due to the reproducible cultivation of this association. This four-year research program will quantify temperature and salinity effects on growth rates and NB2B-fixation rates. It will explore the role of silicate and phosphate (inorganic and organic) in controlling growth rates, chemical composition and NB2B-fixation through host-symbiont interactions. Field studies will address the distribution of both these DDAs and their contribution to Si cycling in large diatom blooms reported from the central N. Pacific gyre.

The mass accumulation of the DDAs in sediment traps as well as in the sedimentary record suggest DDAs are important vectors to depth. The potentially high sinking rates relative to Trichodesmium permit rapid export of new N and sequestration of C. This work will quantify settling rates under conditions of phosphate and silicate-limited growth and provide the first estimates of potential losses due to sinking. This program will provide the first broad characterization of a DDA and provide valuable input data for models.

DDA blooms are potential means to remove C and N quickly from the euphotic zone via mass sedimentation of the diatom host. Diatom remains in sediments suggest this is an important vector for sedimentary deposition. The auteocological work in this study will produce information important for interpreting how such events can occur. In addition, temperature tolerance studies will yield data useful for understanding how this DDA could respond to warming oceans.

The proposed research on Si cycling combined with ongoing studies of C, N and P cycling at station ALOHA will allow, for the first time, an opportunity for a coordinated analysis the cycling of all four of these elements simultaneously in an oligotrophic gyre. The pairing of field work with laboratory studies to determine the role of DDAs will expand understanding of the mechanisms controlling the contribution of diatoms to elemental cycling in open ocean ecosystems.

RELATED PUBLICATIONS

Brzezinski MA, Krause JW, Church MJ, Karl DM, Li B, Jones JL, Updyke B. "The annual silica cycle of the North Pacific subtropical gyre," Deep Sea Research I, v.58, 2011, p. 998.

Duhamel S., Bjorkman K. M., Van Wambeke F., Moutin T., Karl DM. "Characterization of alkaline phosphatase activity in the North and South Pacific Subtropical Gyres: Implications for phosphorus cycling," Limnology and Oceanography, v.56, 2011, p. 1244.

Krause J.W., Brzezinski M.A., Jones J.L. "Application of low-level beta counting of 32Si for the measurement of silica production rates in aquatic environments," Marine Chemistry, v.127, 2011, p. 40.

Krause J.W., Brzezinski M.A., Villareal, T.A., Wilson C. "Increased kinetic efficiency for silicic acid uptake as a driver of summer diatom blooms in the North Pacific subtropical gyre," Limnology and Oceanography, v.57, 2012, p. 1084.

Villareal, T.A.; Adornato, L.; Wilson, C.; Shoenbachler, C.A. "Summer blooms of diatom-diazotroph assemblages (DDAs) and surface chlorophyll in the N. Pacific gyre - a disconnect" Journal of Geophysical Research-Oceans, v.116, 2011, p. DOI: 10.1.

Villareal T.A., Brown, C. G., Brzezinski M.A., Krause J.W., Wilson C.. "Summer Diatom Blooms in the North Pacific Subtropical Gyre: 2008-2009," PLos ONE, v.7, 2012, p. e33109.

Watkins-Brandt K.S., Letelier R.M., Spitz Y.H., Church M.J., Bottjer D., White Angelicque. "Addition of inorganic or organic phosphorus enhances nitrogen and carbon fixation in the oligotrophic North Pacific," Marine Ecology Progress Series, v.432, 2011, p. 17.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0648130

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