

# Mg/Ca ratios in Echinoderms collected near western Antarctica on NBP12-10 (Jan. 1 to Feb. 9, 2013) and LMG13-12 (Nov. 22 to Dec. 20, 2013)

**Website:** <https://www.bco-dmo.org/dataset/727518>

**Data Type:** experimental

**Version:** 1

**Version Date:** 2018-02-21

## Project

- » [The effects of ocean acidification and rising sea surface temperatures on shallow-water benthic organisms in Antarctica](#) (OA\_Antarctic\_organisms)
- » [Genetic connectivity and biogeographic patterns of Antarctic benthic invertebrates](#) (Antarctic Inverts)

## Program

- » [Science, Engineering and Education for Sustainability NSF-Wide Investment \(SEES\): Ocean Acidification \(formerly CRI-OA\)](#) (SEES-OA)

Contributors	Affiliation	Role
<a href="#">McClintock, James B.</a>	University of Alabama at Birmingham (UA/Birmingham)	Principal Investigator
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## Abstract

Mg/Ca ratios in Echinoderms collected on NBP12-10 (Jan. 1 to Feb. 9, 2013) and LMG13-12 (Nov. 22 to Dec. 20, 2013) in Western Antarctica, Bellingshausen Sea to Ross Sea.

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## Coverage

**Spatial Extent:** N:-62.4423 E:-54.62936667 S:-76.9983 W:166.5054933

**Temporal Extent:** 2013-01-01 - 2013-12-20

## Methods & Sampling

Echinoderms were collected during two National Science Foundation (NSF) research cruises: NBP12-10 aboard the U.S. R/V *Nathaniel B. Palmer* (Jan 1 - Feb 9, 2013) and LMG13-12 aboard the U.S. R/V *Laurence M. Gould* (Nov 22 to Dec 20, 2013) around western Antarctica. Individuals were collected using a Blake Trawl (1.5 m width) and bottom temperatures were collected using Seabird SBE3 Oceanographic temperature sensors on a CTD rosette.

To prepare skeletal material, intact individuals or body components were placed in a drying oven for 24 hr at 35 °C and then digested in a 10% NaClO solution to remove all tissue (McClintock et al. 2011). Cleaned skeletal

elements were rinsed generously with distilled water, vacuum dried, and then placed in a drying oven for 24 hrs. Skeletal material from intact individuals or body components was then ground into a fine powder using an agate mortar and pestle with the addition of several mL of 95% ethanol. The resulting slurry was air dried for 12 hrs and the subsequent powder used in mineralogical analysis.

Mg/Ca ratios were determined by X-ray diffraction (XRD) using a Philips X'Pert Analytical X-ray diffraction system (PANalytical B.V., Almelo, Netherlands). The system was set to run at 45kV and 40mV with a  $2\theta$  angular scan range of  $27^\circ$  to  $32^\circ$ . The scan speed was 2 s/step with a step size of 0.02 to obtain accurate measurements of the calcite peak occurring at  $2\theta = 29.5^\circ$ - $30.2^\circ$ . Resulting diffraction patterns was used to determine the Mg/Ca ratio following the equation given in Ries (2011), where " $2\theta$ " is the measured location of the calcite peak on each sample's x-ray diffraction patterns:

$$\text{Mg/Ca} = 0.17881(2\theta)^2 - 10.20926(2\theta) + 145.59368$$

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## Data Files

File
<b>727518.csv</b> (Comma Separated Values (.csv), 84.87 KB) MD5:adff54c464511a115df37fac3b1dbad6 Primary data file for dataset ID 727518

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## Related Publications

Duquette, A., Halanych, K. M., Angus, R. A., & McClintock, J. B. (2018). Inter and intraspecific comparisons of the skeletal Mg/Ca ratios of high latitude Antarctic echinoderms. *Antarctic Science*, 30(3), 160-169. doi:10.1017/s0954102017000566 <https://doi.org/10.1017/S0954102017000566>

*Results*

McClintock, J. B., Amsler, M. O., Angus, R. A., Challener, R. C., Schram, J. B., Amsler, C. D., ... Baker, B. J. (2011). The Mg-Calcite Composition of Antarctic Echinoderms: Important Implications for Predicting the Impacts of Ocean Acidification. *The Journal of Geology*, 119(5), 457-466. doi:[10.1086/660890](https://doi.org/10.1086/660890)

*Methods*

Ries, J. B. (2011). Skeletal mineralogy in a high-CO<sub>2</sub> world. *Journal of Experimental Marine Biology and Ecology*, 403(1-2), 54-64. doi:[10.1016/j.jembe.2011.04.006](https://doi.org/10.1016/j.jembe.2011.04.006)

*Methods*

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## Parameters

Parameter	Description	Units
Sample	Identifier specific to each sample of the dataset	no units
Class	Echinoderm class to which the sample belongs	no units
species	Lowest taxonomic level to which the sample could be identified	no units
body_part	Specific body component used from each echinoderm sample	no units
Theta_2	Measurement provided by x-ray diffraction	degrees
Mg_Ca	Ratio of magnesium to calcium as determined from x-ray diffraction using equation from Ries (2011)	no units
latitude	Latitude for location for which the sample was collected	decimal degrees
longitude	Longitude for location for which the sample was collected	decimal degrees
Depth	Collection depth	meters
Temperature	Water temperature at which the sample was collected	degrees Celsius

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## Instruments

<b>Dataset-specific Instrument Name</b>	Seabird SBE3 Oceanographic temperature sensors on a CTD rosette
<b>Generic Instrument Name</b>	CTD - profiler
<b>Generic Instrument Description</b>	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see <a href="https://www.bco-dmo.org/instrument/869934">https://www.bco-dmo.org/instrument/869934</a> .

<b>Dataset-specific Instrument Name</b>	1.5 meter width Blake Trawl
<b>Generic Instrument Name</b>	Trawl_custom
<b>Generic Instrument Description</b>	A net towed through the water column designed to sample free-swimming nekton or fish, varies in design depending on the research project.

<b>Dataset-specific Instrument Name</b>	Philips X'Pert Analytical X-ray Diffraction system (PANalytical B.V., Almelo, Netherlands)
<b>Generic Instrument Name</b>	X-ray diffractometer
<b>Generic Instrument Description</b>	Instruments that identify crystalline solids by measuring the characteristic spaces between layers of atoms or molecules in a crystal.

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## Deployments

### NBP1210

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/568987">https://www.bco-dmo.org/deployment/568987</a>
<b>Platform</b>	RVIB Nathaniel B. Palmer
<b>Report</b>	<a href="http://dmoserv3.bco-dmo.org/jg/serv/BCO-DMO/OA_Antarctic_organisms/727518.html0%7Bdir=dmoserv3.who.edu/jg/dir/BCO-DMO/OA_Antarctic_organisms/,info=dmoserv3.bco-dmo.org/jg/info/BCO-DMO/OA_Antarctic_organisms/mg_ca_ratios%7D">http://dmoserv3.bco-dmo.org/jg/serv/BCO-DMO/OA_Antarctic_organisms/727518.html0%7Bdir=dmoserv3.who.edu/jg/dir/BCO-DMO/OA_Antarctic_organisms/,info=dmoserv3.bco-dmo.org/jg/info/BCO-DMO/OA_Antarctic_organisms/mg_ca_ratios%7D</a>
<b>Start Date</b>	2013-01-06
<b>End Date</b>	2013-02-09
<b>Description</b>	Seaglider AUV-SG-503-2012 was recovered on this cruise.

### LMG1312

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/666516">https://www.bco-dmo.org/deployment/666516</a>
<b>Platform</b>	ARSV Laurence M. Gould
<b>Report</b>	<a href="http://dmoserv3.bco-dmo.org/jg/serv/BCO-DMO/OA_Antarctic_organisms/727518.html0%7Bdir=dmoserv3.who.edu/jg/dir/BCO-DMO/OA_Antarctic_organisms/,info=dmoserv3.bco-dmo.org/jg/info/BCO-DMO/OA_Antarctic_organisms/mg_ca_ratios%7D">http://dmoserv3.bco-dmo.org/jg/serv/BCO-DMO/OA_Antarctic_organisms/727518.html0%7Bdir=dmoserv3.who.edu/jg/dir/BCO-DMO/OA_Antarctic_organisms/,info=dmoserv3.bco-dmo.org/jg/info/BCO-DMO/OA_Antarctic_organisms/mg_ca_ratios%7D</a>
<b>Start Date</b>	2013-11-22
<b>End Date</b>	2013-12-20
<b>Description</b>	Benthic invertebrate studies

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## Project Information

**The effects of ocean acidification and rising sea surface temperatures on shallow-water benthic organisms in Antarctica (OA\_Antarctic\_organisms)**

**Coverage:** Palmer Station, Antarctica; 64.7667 S, 64.05 W

*Extracted from the NSF award abstract:*

The research will investigate the individual and combined effects of rising ocean acidification and sea surface temperatures on shallow-water calcified benthic organisms in western Antarctic Peninsular (WAP) marine communities. The Southern Ocean is predicted to become undersaturated in terms of both aragonite and calcite within 50 and 100 years, respectively, challenging calcification processes. Adding to the problem, antarctic calcified benthic marine organisms are more vulnerable to ocean acidification than temperate and tropical species because they are generally weakly calcified. Many antarctic organisms are essentially stenothermal, and those in the West Antarctic Peninsula are being subjected to rising seawater temperatures. The project employs both single-species and multi-species level approaches to evaluating the impacts of rising ocean acidification and seawater temperature on representative calcified and non-calcified macroalgae, on calcified and non-calcified mesograzers, and on a calcified macro-grazer, all of which are important ecological players in the rich benthic communities. Multi-species analysis will focus on the diverse assemblage of amphipods and mesogastropods that are associated with dominant macroalgae that collectively play a key role in community dynamics along the WAP.

**NOTE:** Charles Amsler is listed as a former Co-PI of this project.

Data Access:

Data from this project have been submitted to the Antarctic Master Directory Portal of NASA's Global Change Master Directory, and can be accessed through the publication reference:

[Schram, J.B., K.M Schoenrock, J.B. McClintock, C.D. Amsler, R.A. Angus. 2014. Multiple stressor effects of near-future elevated seawater temperature and decreased pH on righting and escape behaviors of two common Antarctic gastropods. Journal of Experimental Marine Biology and Ecology 475:90-96. DOI link: <http://dx.doi.org/10.1016/j.jembe.2014.04.005>](http://dx.doi.org/10.1016/j.jembe.2014.04.005)

## **Genetic connectivity and biogeographic patterns of Antarctic benthic invertebrates (Antarctic Inverts)**

**Coverage:** Antarctica

*Extracted from the NSF award abstract:*

The research will explore the genetics, diversity, and biogeography of Antarctic marine benthic invertebrates, seeking to overturn the widely accepted suggestion that benthic fauna do not constitute a large, panmictic population. The investigators will sample adults and larvae from undersampled regions of West Antarctica that, combined with existing samples, will provide significant coverage of the western hemisphere of the Southern Ocean. The objectives are: 1) To assess the degree of genetic connectivity (or isolation) of benthic invertebrate species in the Western Antarctic using high-resolution genetic markers. 2) To begin exploring planktonic larvae spatial and bathymetric distributions for benthic shelf invertebrates in the Bellinghausen, Amundsen and Ross Seas. 3) To continue to develop a Marine Antarctic Genetic Inventory (MAGI) that relates larval and adult forms via DNA barcoding.

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## **Program Information**

**Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)**

**Website:** [https://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=503477](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477)

**Coverage:** global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF ([https://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=504707](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707)).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

#### **Solicitations issued under this program:**

[NSF 10-530](#), FY 2010-FY2011

[NSF 12-500](#), FY 2012

[NSF 12-600](#), FY 2013

[NSF 13-586](#), FY 2014

NSF 13-586 was the final solicitation that will be released for this program.

#### **PI Meetings:**

[1st U.S. Ocean Acidification PI Meeting](#) (March 22-24, 2011, Woods Hole, MA)

[2nd U.S. Ocean Acidification PI Meeting](#) (Sept. 18-20, 2013, Washington, DC)

3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

#### **NSF media releases for the Ocean Acidification Program:**

[Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification](#)

[Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?](#)

[Discovery nsf.gov - National Science Foundation \(NSF\) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation \(NSF\)](#)

[Press Release 12-179 nsf.gov - National Science Foundation \(NSF\) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation \(NSF\)](#)

[Press Release 13-102 World Oceans Month Brings Mixed News for Oysters](#)

[Press Release 13-108 nsf.gov - National Science Foundation \(NSF\) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation \(NSF\)](#)

[Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants](#)

[Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation \(NSF\)](#)

[Press Release 14-010 nsf.gov - National Science Foundation \(NSF\) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation \(NSF\)](#)

[Press Release 14-116 nsf.gov - National Science Foundation \(NSF\) News - Ocean Acidification: NSF awards \\$11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation \(NSF\)](#)

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## **Funding**

Funding Source	Award
<a href="#">NSF Antarctic Sciences (NSF ANT)</a>	<a href="#">PLR-1041022</a>
<a href="#">NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)</a>	<a href="#">PLR-1043745</a>

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