Isotopes delta-11B, delta-13C and delta-18O in deep-sea bamboo corals Keratoisis (Bamboo Coral Boron Isotopes project)

Website: https://www.bco-dmo.org/dataset/542928
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Project
» Calibration and application of the boron isotope seawater-pH indicator in deep-water corals (Bamboo Coral Boron Isotopes)

Contributors	Affiliation	Role
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Dataset Description

δ^{11}B, δ^{13}C and δ^{18}O in deep-sea bamboo corals

References to detailed boron isotope methodology:
Foster G. L., Hönisch B., Paris G., Dwyer G. S., Rae J. W. B., Elliott T., Gaillardet J., Hemming N. G., Louvat P. and Vengosh A. (2013) Interlaboratory comparison of boron isotope analyses of boric acid, seawater and marine $CaCO_3$ by MC-ICPMS and NTIMS. *Chem. Geol.* **358**, 1-14, doi:10.1016/j.chemgeo.2013.08.027.

Penman D. E., Hönisch B., Rasbury E. T., Hemming N. G. and Spero H. J. (2013) Boron, carbon, and oxygen isotopic composition of brachiopod shells: Intra-shell variability, controls, and potential as a paleo-pH recorder. *Chem. Geol.* **340**, 32-39.

Methods & Sampling

Sampling and Analytical Methodology:
Forty to sixty µg splits of drilled coral samples were analyzed for carbon and oxygen stable isotopes without chemical pretreatment or roasting. Samples were analyzed on a Thermo Delta V+ with dual inlet and Kiel IV device at the Lamont-Doherty Earth Observatory (LDEO), with values reported in per mil relative to the Vienna Pee-Dee Belemnite (VPDB). The 1σ analytical accuracy for δ^{13}C and δ^{18}O based on replicate analyses of laboratory standards are ±0.03‰ and ±0.06‰, respectively. When available, replicate analyses of individual coral samples were precise to within ±0.05‰ for δ^{13}C and ±0.08‰ for δ^{18}O (1σ).

For boron isotope analyses, 1 to 2 mg of calcite powder was cleaned of organic material with 1% H_2O_2 buffered in 0.1N NaOH at 80°C for twenty minutes, then rinsed five times with boron-free MilliQ water under ultrasonication. Recovery varied from 70 to 90%, as fine-grained material was invariably lost to suspension during rinse steps. Cleaned coral powders were dissolved in 2N HCl immediately prior to analysis; Fisher

Optima® grade chemicals were used for all treatments. A sufficient volume of analyte to obtain a minimum of 1 ng of B (typically 1.5 to 2 µL depending on sample B concentration) was loaded with 1.0 µL of a boron-free seawater matrix solution onto degassed rhenium filaments.

Boron isotope ratios were measured on a Thermo TRITON multicollector thermal ionization mass spectrometer at LDEO in negative-ion mode (NTIMS, see detailed methodology in Foster et al., 2013). Average electric potentials for $^{11}BO_2^-$ ranged between 120 and 300 mV. Boron isotope ratios are reported in delta notation ($\delta^{11}B$) relative to the NIST 951 boric acid standard reference material. Mass 26 ($^{12}C^{14}N^-$) was monitored immediately prior to analyses, to check for isobaric interference on $^{10}BO_2^-$ from organic material. No samples were excluded based on this criterion, as mass 26 counts were below previously determined thresholds for organic matter contamination (Foster et al., 2013). Boron concentrations were determined in a representative sample for each coral by isotope dilution with 5 ppm NIST 952 boric acid reference material. A minimum of three acceptable repeat analyses was required for each reported $\delta^{11}B$ value, where analyses with >1‰ within-run fractionation were discarded. Although only two acceptable repeat analyses were obtained for five samples, these numbers are reported here because of their close correspondence with surrounding measurements (italicized $\delta^{11}B$ values in dataset).

Uncertainty in $\delta^{11}B$ measurements is reported as the larger value of either twice the measurement standard error (2se=2σ/√n, where n is the number of repeat analyses on a single sample solution), or the external error, which is given as the 2se on repeat analyses of an in-house standard of NIST 951 precipitated in vaterite (see Foster et al., 2013 and Penman et al., 2013).

Data Processing Description

Data Processing:
Isotope ratios reported in delta notation relative to standards (NBS951 for boron, Vienna Pee Dee Belemenite for carbon and oxygen):
δxZ (‰) = (((xZ/yZsample)/(xZ/yZstandard))-1)*1000 for element Z with stable isotopes x and y.

BCO-DMO Processing Notes
- Generated from original file: "DATASET-11B13C18O.xlsx" contributed by Jesse Farmer
- Parameter names edited to conform to BCO-DMO naming convention found at Choosing Parameter Name
- Lat/Lon sampling locations added from locations dataset to allow plotting in MapServer
- "nd" (no data) added to blank cells

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Data Files

File
BC_11B13C18O.csv (Comma Separated Values (.csv), 5.40 KB) MD5:4b03fdf19702f02c7470553ec007e56c Primary data file for dataset ID 542928

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Parameters

Parameter	Description	Units
Coral	Specimen Identifier	text
Lat	Sample Latitude Location (South is negative)	decimal degrees
Lon	Sample Longitude Location (West is negative)	decimal degrees
Sample	Sample Type: D= diamond rotary drill; MM= micromill; S= outer surface sample (taken with rotary drill)	text
Depth_from_distal_surface	Length scales for samples either relative to the outside of the coral (distal surface) or from the coral center	mm
Distance_from_center	Length scales for samples either relative to the outside of the coral (distal surface) or from the coral center	mm
Delta11B	11B - Boron isotope ratio - Isotope ratio reported in delta notation relative to standards (NBS951 for boron)	‰
Reported_Error	the larger of the two error columns (sem_2 and External_2se)	‰
sem_2	Twice the measurement standard error	‰
External_2se	External error	‰
n	Number of repeat δ11B analyses on a single sample solution	integer
Delta13C	13C - Carbon isotope ratio - Isotope ratio reported in delta notation relative to standards (Vienna Pee Dee Belemenite for carbon and oxygen)	‰
Delta18O	18O - Oxygen isotope ratio - Isotope ratio reported in delta notation relative to standards (Vienna Pee Dee Belemenite for carbon and oxygen)	‰
QF	X = Those samples that represent only two repeat analyses or n=2	na

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Instruments

Dataset-specific Instrument Name	IR Mass Spec - Thermo Delta V+
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Samples were analyzed on a Thermo Delta V+ with dual inlet and Kiel IV device at the Lamont-Doherty Earth Observatory (LDEO)
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	TI Mass Spec - Thermo TRITON multicollector thermal ionization mass spectrometer
Generic Instrument Name	Thermal Ionization Mass Spectrometer
Dataset-specific Description	Boron isotope ratios were measured on a Thermo TRITON multicollector thermal ionization mass spectrometer at LDEO in negative-ion mode (NTIMS, see detailed methodology in Foster et al., 2013)
Generic Instrument Description	A Thermal Ionization Mass Spectrometer (TIMS) is an instrument that measures isotopic ratios after electrical excitation of a sample causes ionization of the isotopes.

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Deployments

BambooCoral_Hoenisch

Website	https://www.bco-dmo.org/deployment/542792
Platform	shoreside BAMBOO CORAL
Start Date	1879-01-01
End Date	2009-12-31
Description	Locations for studied bamboo corals

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Project Information

Calibration and application of the boron isotope seawater-pH indicator in deep-water corals (Bamboo Coral Boron Isotopes)

Coverage: Global sample locations

Description from NSF award abstract:
Anthropogenic CO2 enters the ocean in the high latitudes, from where it spreads into the deep ocean interior. Because carbonate ion saturation at greater water depth is generally reduced in the deep ocean, deep-sea corals may be particularly vulnerable to ocean acidification. Efforts are needed to determine the effects of changing seawater chemistry on these ecosystems, and in particular reconstructions of past pH-variations experienced by these corals may help to implement long-term management plans for deep-sea coral reefs. This project will provide new insight into the effect of changing seawater carbonate chemistry and anthropogenic ocean acidification on deep-sea coral reefs. The researchers will calibrate the boron isotope and B/Ca paleo-pH proxies in several species of modern and cultured deep-sea corals. The resulting proxy calibrations will be used to interpret the boron isotope composition of live collected and fossil deep-sea corals with regard to past ocean pH changes. Live collected corals from the North Atlantic and Southern Ocean will provide ultra-high resolution temporal records of anthropogenic CO2 invasion at intermediate depths. Radiometrically dated corals from the same locations will be used to document pH changes in the deep ocean over the last deglaciation. Comparison of paleo-pH with already established changes in coral species composition will allow interpretation of coral sensitivity to ocean acidification. The project will also improve paleo-pH reconstructions by cross- calibrating the principal techniques of boron isotope analysis.

Related Reference:

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1041133

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