Cross Seamount modern (live) coral radiocarbon data and age modeled dates

Website: https://www.bco-dmo.org/dataset/884969
Version: 1
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Project
» Development and application of CSI-AA biogeochemistry reconstructions in deep-sea corals to study decadal-centennial variability in the North Pacific (Deep Sea Coral Reconstruction)

Contributors	Affiliation	Role
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Abstract
This dataset contains radiocarbon data and age modeled dates from modern (living) deep-sea proteinaceous corals (Kulamanamana haumaeae) collected from 447 and 415 m respectively from Cross Seamount (19°N, 158°W), southwest of the Big Island of Hawaii, in 2004 using the DSRV Pisces V. Radiocarbon on data and age modeled dates calculated using Calib Calibration 8.1 (Stuiver et al., 2021) and Marine20 Calibration curve (Heaton et al., 2020). These data were generated as part of a study of the preservation of stable isotope ratios in deep-sea proteinaceous coral skeletons over 1000s of years. Study results were published in Glynn et al. (2022). Study description: Paleoproxy records in deep-sea proteinaceous coral skeletons can reconstruct past ocean conditions on centennial to millennial time scales. Commonly recovered subfossil specimens could potentially extend these archives through the Holocene. However, protein matrix stability and integrity of stable isotope proxies over multi-millennial timescales in such specimens have never been examined. Here we compare amino acid (AA) composition together with bulk and AA compound-specific carbon (δ13C) and nitrogen (δ15N) isotopes in live-collected and subfossil (~9.6-11.6 kyrs BP) Kulamanamana haumeaae deep-sea coral specimens from the central Pacific to understand the effects of long-duration benthic oxic exposure on primary coral chemistry. We find large coupled shifts in bulk δ15N (~7‰) and δ13C (~2‰) in the outermost portion (0-10 mm) of the subfossil coral, coincident with extensive alteration of the protein matrix. Microstructural changes in skeletal texture coincide with higher C/N ratios (+0.8) and isotope-based amino acid degradation parameters (e.g. ΣV ≥3), indicating extensive degradation of seawater-exposed gorgonin. However, interior gorgonin (>10 mm) retained amino acid molecular compositions (with exception of major Glycine loss) and bulk and amino acid-specific isotopic values that were similar to live-collected specimens. These results indicate that compound-specific isotope analysis of amino acids can reconstruct paleo-oceanographic biogeochemical and ecosystem information in subfossil corals beyond a clear diagenetic horizon, which is easily identifiable from an evaluation of C/N ratios together with the ΣV degradation proxy.

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Coverage

Spatial Extent: **Lat**:19 **Lon**:-158
Temporal Extent: 2004-10-06 - 2004-10-11

Methods & Sampling

Living and subfossil deep-sea proteinaceous corals (Kulamanamana haumaeae) were collected from 447 and 415 m respectively from Cross Seamount (19°N, 158°W), southwest of the Big Island of Hawaii, in 2004 using the DSRV Pisces V. See related dataset (https://www.bco-dmo.org/dataset/883713) for results from subfossil corals.

The polyps of live-collected corals were removed and all skeletons were rinsed first with seawater, followed by freshwater, before being air dried on deck. In the lab, ~0.7 cm thick cross-sectional disks were sectioned from near the base of each skeleton, then polished and mounted to glass slides.

A computerized Merchanteck micromill was used to drill a radial transect from the outside to the inner layers of the coral skeleton cross section at 0.1 mm resolution, yielding 2-3 mg of powdered skeletal material per sample interval. All 168 samples from the live-collected coral were analyzed (155 samples in duplicate); while of the 455 subfossil samples drilled, 193 were analyzed, with a greater sample density analyzed from the outermost 10 mm. Bulk powdered coral material (~0.4 mg) was enclosed in tin capsules for bulk δ13C and δ15N analyses via continuous-flow isotope-ratio mass spectrometry (IRMS) using a Carlo-Erba elemental analyzer connected to an Optima Isotope Ratio Mass Spectrometer (IRMS). C/N ratios were simultaneously determined. The analytical error for these measurements, as determined from analysis of standards of known composition (pugel and acetanilide), was ±0.2‰ for both δ13C and δ15N values and ±0.1 for C/N ratios. To test for the impact of secondary authigenic carbonate in the sample matrix, a subset of the same samples from the subfossil coral (1–2 mg each, n = 7) were acidified using 1 N HCl for 20 h under refrigerated conditions, followed by filtration onto a 0.22 µm glass fiber filter. The filter was dried overnight at 45°C before material was transferred into a tin capsule and analyzed following the same procedure as described above.

Radiocarbon dating was performed on nine sample aliquots (~1 mg total material) each spread ~5 mm apart along the skeleton cross section transect. Samples were first fumed with concentrated HCl and subsequently dried before being transferred with methanol into 6 mm short pre-baked (400C, 60 minutes) quartz tubes and dried. The 6 mm tubes were then placed inside larger 9 mm pre-baked (400C, 60mins) quartz tubes with an appropriate amount of pre-baked (400C, 60 mins) CuO, prior to pumping off excess atmosphere, sealing, and combusting to produce CO2. The CO2 after cryogenic purification was converted to graphite and analyzed at the Lawrence Livermore National Laboratory. Results were corrected for δ13C and background 14C using similarly handled 14C-free coal. Radiocarbon results were transformed into calibrated years before present (yr BP). These ages and subsequent age models were generated with Calib 8.2 (Stuiver et al. 2021) using a local reservoir (ΔR) correction of -177 ± 16, (Druffel et al., 2001; Guilderson et al., 2021) and the Marine20 database (Heaton et al. 2020) and linearly interpreted to provide a continuous age-model.

Issue Report:
For modern (live-collected) coral (Coral_Sample_ID: PV590), CAMS# 157843, PV 590 14.0mm was a 40µgC target. This is why the error is larger.

BCO-DMO Curation Notes

* The data table for this dataset was generated by extracting the data table from:
 ** BCO_CrossSeamounnt_Modern.xlsx Sheet "Cross Seamount Ku spp. LIVE"
* Metadata contained in comments in the above-mentioned sheets were added to the Methods & Sampling section of this dataset page.
* Sample information (specimen id, date, water depth, etc) were extracted from comments in the sheet and added as values in a data column in the main data table.
* Column names edited to conform to BCO-DMO naming conventions (no special characters, can't start with a number, etc).

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Related Datasets

IsRelatedTo

Guilderson, T. (2022) **Radiocarbon data and age modeled dates from subfossil deep-sea proteinaceous corals (Kulamanamana haumaeae) collected using the DSRV Pisces V at Cross Seamount in 2004.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1)

Version Date 2022-11-15 http://lod.bco-dmo.org/id/dataset/883713 [view at BCO-DMO]
Relationship Description: Data from subfossil corals collected as part of this study.

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Development and application of CSI-AA biogeochemistry reconstructions in deep-sea corals to study decadal-centennial variability in the North Pacific (Deep Sea Coral Reconstruction)

Coverage: North Pacific, including Central California Coast (eg Monterey Bay, Sur Ridge, Pioneer Seamount), Gulf of Alaska, North Pacific Gyre (eg Main Hawaiian Islands)

NSF Award Abstract:
Oceanic biological-ecosystem variability reflects dynamic physical processes in the ocean. This research aims to use newly-developed, state-of-the-art analyses of the chemical composition of deep-sea corals to examine how biogeochemical changes and shifts in plankton populations are related to environmental changes over the past few centuries. The project focuses on the Northeast Pacific Arc, which includes the Gulf of Alaska and the California Current System (CCS). Here instrumental records of sea surface temperature, sea level pressure, and coastal surface temperature reveal a consistent pattern of multi-decadal-scale changes in the North Pacific Basin. Funding supports training of one graduate student, one postdoctoral fellow, and offers research experiences for UCSC undergraduates, community college students, and high school students. The research team has partnered with the UCSC Seymour Marine Discovery Center to establish a new permanent exhibit highlighting deep-sea corals and climate-related ecosystem change.

The central goal of this research is to couple high resolution records of past environments derived from deep-sea proteinaceous corals together with new compound-specific amino acid isotope (CSI-AA) measurements to create reconstructions of both biogeochemical change (e.g., source of nitrogen) and basic plankton ecosystem shifts crossing the Northeast Pacific Arc. Using sediment trap and live-collected samples, the research team will develop a more intimate understanding of, and establish explicit links between export production and the CSI-AA baseline values and patterns recorded in proteinaceous deep-sea corals. They will apply this knowledge to provide new insight into the underlying mechanisms of North East Pacific ecosystem change over the last 300-500 years. Overarching questions guiding this research are: 1) Are there structural, secular, long-term changes in NE Pacific Arc food webs beyond the Pacific Decadal Oscillation?, 2) If yes, how are these reflected in the community structure at the base of the food web?, and 3) How has community structure and sources of nitrate at the base of the food-web shifted in response to these changes?

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1635527

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