# Time course experiment related data to validate incubation duration for methane oxidation rate measurement of the deep Santa Barbara Basin water column from September 2019 (BASIN project)

**Website**: https://www.bco-dmo.org/dataset/872687
**Data Type**: Cruise Results, experimental
**Version**: 1
**Version Date**: 2022-04-05

**Project**
» Collaborative Research: Chemical and microbiological studies of water-soluble alkanes in the ocean (CASA)
» Collaborative Research: Do benthic feedbacks couple sulfur, nitrogen and carbon biogeochemistry during transient deoxygenation? (BASIN)


| Contributors | Affiliation | Role |
|---|---|---|
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**Abstract**
This time course experiment was performed to test if the uptake rate of 3H-CH4 is linear over the chosen incubation time (3 days) for the seawater samples.

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## Coverage

**Spatial Extent**: **Lat**:34 **Lon**:-120
**Temporal Extent**: 2019-09-24

### Methods & Sampling

**Methodology:**

**Sampling and analytical procedures:**

Methane concentrations were measured by headspace equilibration method, modified from Kinnaman et al., 2007.

Fractional methane turnover rates were analyzed based on the 3H-labeled methane incubation protocol by Bussmann et al., 2015.

Methane oxidation rates were calculated assuming adherence to the first-order rate law, by multiplying fractional methane turnover rate and ambient methane concentration (Valentine et al., 2001).

Samples were collected from R/V Connell.

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## Data Files

| File |
|---|
| **qianhui_qin_-_time_course_exp.csv**(Comma Separated Values (.csv), 749 bytes) MD5:1558be88f9cd847e182668a0e1a1d4c2<br>Primary data file for dataset ID 872687 |

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## Related Publications

Bussmann, I., Matousu, A., Osudar, R., & Mau, S. (2015). Assessment of the radio 3 H-CH4 tracer technique to measure aerobic methane oxidation in the water column. Limnology and Oceanography: Methods, 13(6), 312–327. doi:10.1002/lom3.10027
*Methods*

Kinnaman, F. S., Valentine, D. L., & Tyler, S. C. (2007). Carbon and hydrogen isotope fractionation associated with the aerobic microbial oxidation of methane, ethane, propane and butane. Geochimica et Cosmochimica Acta, 71(2), 271–283. doi:10.1016/j.gca.2006.09.007
*Related Research*

Qin, Q., Kinnaman, F. S., Gosselin, K. M., Liu, N., Treude, T., & Valentine, D. L. (2022). Seasonality of water column methane oxidation and deoxygenation in a dynamic marine environment. Geochimica et Cosmochimica Acta, 336, 219–230. https://doi.org/10.1016/j.gca.2022.09.017
*Results*

Valentine, D. L., Blanton, D. C., Reeburgh, W. S., & Kastner, M. (2001). Water column methane oxidation adjacent to an area of active hydrate dissociation, Eel river Basin. Geochimica et Cosmochimica Acta, 65(16), 2633–2640. doi:10.1016/s0016-7037(01)00625-1 https://doi.org/10.1016/S0016-7037(01)00625-1
*Methods*

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## Related Datasets

### IsRelatedTo

Qin, Q., Valentine, D. L., Treude, T., Kinnaman, F. S., Gosselin, K. M., Liu, N. (2022) **Initial Methane Concentration Alteration Experiment Data of the Deep Santa Barbara Basin Water Column from October 2019 (BASIN project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-04-05 doi:10.26008/1912/bco-dmo.872652.1 [view at BCO-DMO]
*Relationship Description: Time course experiment, together with initial oxygen and methane alteration experiments, serve as supports of the assumptions of the method.*

Qin, Q., Valentine, D. L., Treude, T., Kinnaman, F. S., Gosselin, K. M., Liu, N. (2022) **Initial Oxygen**

**Concentration Alteration Experiment Data of the Deep Santa Barbara Basin Water Column from October 2019 (BASIN project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-04-05 doi:10.26008/1912/bco-dmo.872665.1 [view at BCO-DMO]
*Relationship Description: Time course experiment, together with initial oxygen and methane alteration experiments, serve as supports of the assumptions of the method.*

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## Parameters

| Parameter | Description | Units |
|---|---|---|
| Incubation_time_day | incubation time of seawater samples; harvest sample days are either 1 (day 1), 2 (day 2), or 2.85 (day 3 at an earlier collection time than days 1 and 2) | unitless |
| Depth_m | sampling depths of sea water samples | m |
| Percentage_of_tracer_converted | the percentage of injected tracer 3H-CH4 that is converted to 3H-H2O | unitless |

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## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | Seabird SBE 19plusV2 Seacat Profiler System |
| **Generic Instrument Name** | CTD Sea-Bird SBE SEACAT 19plus |
| **Dataset-specific Description** | Seawater sampling was performed using a rosette equipped with 6 4-liter Niskin bottles, the in-situ temperatures of the water samples were recorded by the conductivity–temperature–depth recorder (CTD), a Seabird SBE 19plusV2 Seacat Profiler system attached to the rosette. |
| **Generic Instrument Description** | Self contained self powered CTD profiler. Measures conductivity, temperature and pressure in both profiling (samples at 4 scans/sec) and moored (sample rates of once every 5 seconds to once every 9 hours) mode. Available in plastic or titanium housing with depth ranges of 600m and 7000m respectively. Minature submersible pump provides water to conductivity cell. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | 6 4-liter Niskin bottles |
| **Generic Instrument Name** | Niskin bottle |
| **Dataset-specific Description** | Seawater sampling was performed using a rosette equipped with 6 4-liter Niskin bottles, the in-situ temperatures of the water samples were recorded by the conductivity–temperature–depth recorder (CTD), a Seabird SBE 19plusV2 Seacat Profiler system attached to the rosette. |
| **Generic Instrument Description** | A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc. |

## Project Information

### Collaborative Research: Chemical and microbiological studies of water-soluble alkanes in the ocean (CASA)

**Coverage**: Coal Oil Point, Santa Barbara, CA and Gulf of Mexico

*NSF Abstract:*
This research project addresses the fate of hydrocarbons that enter the ocean, using geological oil seeps as a natural scientific laboratory. The key issues of intellectual merit that will be addressed focus on the development and application of methodology to determine how the chemical properties of hydrocarbon molecules dictate whether they will be trapped in the ocean's interior or find their way to the atmosphere. The research will further follow the fate of these molecules in the ocean's interior, determining how the ocean's bacterial population responds, and the extent to which responding bacteria will degrade these molecules. The broader impacts of this research will include the training of undergraduate and graduate students in scientific research and at-sea oceanographic training, as well as the dissemination of findings to policy makers striving to understand the fate and effects of hydrocarbons in the ocean.

Hydrocarbons enter the ocean through a combination of natural seepage, anthropogenic discharge and biological production, with profound impacts on ocean biogeochemistry, ecology, and the atmosphere. This research project addresses the chemical and biological processes affecting water-soluble alkanes in the ocean, using natural seeps to study their fluxes, partitioning between ocean and atmosphere, and the bacterial response to their input. The intellectual merit of this research pertains to the behavior of highly volatile hydrocarbons, a class that is abundant in petroleum reservoirs and many crude and refined products, but is poorly understood in the ocean. Volatile hydrocarbons display distinct behaviors compared with traditional oil in that they will partition to seawater or the atmosphere depending on their molecular structure and the context by which they enter the ocean, a combination of characteristics unsuitable for traditional fate and transport models that govern our understanding of liquid oil. This research project addresses this gap in knowledge through a plan to study volatile, water-soluble hydrocarbons in the context of natural seepage, focusing on key questions about their transport and fate, and the ocean's microbial response. Two key questions include: 1) What factors control the partitioning of water-soluble alkanes between water and the atmosphere at natural seeps, and how does this affect their availability to microbes? 2) What genomic and metabolic factors enable the microbial response to the input of water-soluble alkanes and how does the microbial response vary with regional oceanographic and geologic factors such as proximity to and flux from natural seepage? The hypotheses that result from these questions will be tested through a series of oceanographic and laboratory-based experiments designed around natural oil seeps in the Pacific and in the Gulf of Mexico. The results of these studies promise to inform our understanding of the transport, fate, and effects of water-soluble alkanes in the ocean.

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.

### Collaborative Research: Do benthic feedbacks couple sulfur, nitrogen and carbon biogeochemistry during transient deoxygenation? (BASIN)

**Coverage**: Santa Barbara Basin, California, USA

*NSF Award Abstract:*
This study focuses on chemical processes that occur in oxygen-limited waters along the world's continental margins. These processes are influenced by the activities of microbes and control the fate of key elements that are deposited to sediments in these areas including carbon, nitrogen and sulfur. As a result, they are key to the health and function of the ocean. The intellectual merit of this research is to study the coupled chemical and microbial processes that occur in these environments by combining robotic technology with experiments that will be conducted at the ocean floor and in the shipboard laboratory. The broader impacts of this project

will provide at-sea training and educational opportunities to undergraduate and graduate students and the results will be broadly distributed to stakeholders and interested parties. Results from this research promise to identify and quantify rates for key processes that couple carbon, nitrogen and sulfur in marine environments adjacent to the continents. The project addresses an important aspect of environmental change in the ocean (i.e., decreased oxygen due to warming and nutrient enrichment) and its influence on chemical and biological cycles and ocean ecosystems.

The dynamics of oxygen minimum zones along continental margins, and their potential for future expansion, are important because of their intersection with global biogeochemical cycles and because of their far-reaching impacts on ocean ecosystems. However, the impacts of transient deoxygenation on biogeochemical cycles of carbon, nitrogen and sulfur at the sea floor are not well established and are the focus of this study. This study will test the overarching hypothesis that deoxygenation triggers a positive feedback loop between bacterial mats at the sea floor that consume hydrogen sulfide, a sulfur species that can be toxic to higher organisms, and an underlying community of bacteria that produce hydrogen sulfide. By this hypothesis, the establishment of sea floor mats, which depend on inorganic nitrogen sources to run their sulfur metabolism, accelerates nitrogen cycling in the uppermost sediment horizon following deoxygenation. The accelerated nitrogen cycling allows for upward expansion of the sulfide-producing bacteria, which in-turn provide a shallow source of sulfide as substrate to further support nitrogen cycling in the sea floor mat. The results of this study will enable understanding of the relationship between oxygen dynamics in the water column and the biogeochemical processes at the sea floor that link the transformations of carbon, nitrogen and sulfur. The results of this study promise to define the environmental conditions under which the sulfur and nitrogen cycles are coupled and subject to strong positive feedbacks at the seafloor, as well as the conditions under which they are decoupled. This study provides training in research and innovative analytical and experimental techniques to four graduate students and several undergraduates. Undergraduates will be engaged in research at two institutions, one of which has recently been designated as a Hispanic serving institution. Approximately 10 undergraduate students (20 in total) will participate in each of the two proposed oceanographic expeditions, through an established course entitled: Field Studies in Marine Biogeochemistry. This course provides an opportunity for students to develop an independent research project in advance of the expedition, to participate on the expedition, and to conduct research projects while at sea.

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.

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## Funding

| Funding Source | Award |
|---|---|
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1756947 |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1756667 |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1756242 |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1829981 |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1830033 |

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