

# Fall 2011 - Water Column Samples

**Website:** <https://www.bco-dmo.org/dataset/644504>

**Version:** 20 April 2016

**Version Date:** 2016-04-20

## Project

» [Collaborative Research: Degrading offshore permafrost as a source of methane on the East Siberian Arctic Shelf](#) (East Siberian Arctic Shelf)

Contributors	Affiliation	Role
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## Dataset Description

Siberia Cruise Porewater Samples Collected Sept-Oct, 2011

## Methods & Sampling

Fall 2011 - Water Column Samples

### References:

Joye SB, Bowles M.W., Samarkin V.A., Hunter K.S., Niemann H.. 2010. Biogeochemical signatures and microbial activity of different cold seep habitats along the Gulf of Mexico lower slope. Deep Sea Research. 10:doi:10.1016/j.dsr2.2010.06.001.

Joye SB, MacDonald I.R., Leifer I., Asper V.. 2011. Magnitude and oxidation potential of hydrocarbon gases released from the BP blowout. Nature Geoscience. 4:160-164.

Orcutt B.N., Samarkin V., Boetius A., Elvert M., Joye SB. 2005. Molecular biogeochemistry of sulfate reduction, methanogenesis and the anaerobic oxidation of methane at Gulf of Mexico methane seeps. Geochimica et Cosmochimica Acta. 69:4267-4281.

## Data Processing Description

## BCO-DMO Processing Notes

- Generated from original file "00908788\_Joye\_Fall-2011\_Data-Summary.xlsx", Sheet: "Water Column" contributed by Samantha Joye
- Parameter names edited to conform to BCO-DMO naming convention found at [Choosing Parameter Name](#)
- "nd" (no data) inserted into blank cells
- blank rows removed
- "B.D.L." converted to "BDL" (periods removed) to avoid potential data errors downstream
- "N.S." converted to "NS" (periods removed) to avoid potential data errors downstream and for consistency

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## Data Files

File
<b>Fall2011_Water_Column.csv</b> (Comma Separated Values (.csv), 11.50 KB) <small>MD5:45d9f34f0493301cac16520658b87d1f</small> Primary data file for dataset ID 644504

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## Parameters

Parameter	Description	Units
Sample_No	Sample No	dimensionless
Water_Column_Sample_ID	Water Column Sample ID	dimensionless
Station	Station	dimensionless
Latitude	Station latitude (South is negative)	decimal degrees
Longitude	Station longitude (West is negative)	decimal degrees
Total_Depth	Total_Depth	meters
Sample_Depth	Sample_Depth	meters
Temp	Temp	°C
pH	pH	pH units
Salinity	Salinity	PSU
DOC	DOC	uM
TDN	TDN	uM
NOx	NOx (Nitrate + Nitrite)	uM
NO2	NO2	uM
NH4	NH4	uM
TDP	TDP	uM
PO4	PO4	uM
Si	Si	uM
CH4	CH4	nM
CH4_MOX_Sheet	CH4 (MOX Sheet)	nM
MOX	MOX	(tbd)

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## Instruments

<b>Dataset-specific Instrument Name</b>	Drill Core
<b>Generic Instrument Name</b>	Drill Core
<b>Generic Instrument Description</b>	A core drill is a drill specifically designed to remove a cylinder of material, much like a hole saw. The material left inside the drill bit is referred to as the core. Core drills are used frequently in mineral exploration where the coring may be several hundred to several thousand feet in length. The core samples are recovered and examined by geologists for mineral percentages and stratigraphic contact points. This gives exploration companies the information necessary to begin or abandon mining operations in a particular area.

<b>Dataset-specific Instrument Name</b>	Lachat Instruments FIA+ 8000 Series
<b>Generic Instrument Name</b>	Flow Injection Analyzer
<b>Dataset-specific Description</b>	Porewater samples collected for: NO <sub>x</sub> (Nitrate + Nitrite) Nitrite Orthophosphate Reactive Silicate Analytical Method: Flow Injection Autoanalyzer Instrument: Lachat Instruments FIA+ 8000 Series Method Reference(s): Lachat Instruments FIA 8000 Autoanalyzer Method 31-107-04-1-A Lachat Instruments FIA 8000 Autoanalyzer Method 31-115-01-1-H Lachat Instruments FIA 8000 Autoanalyzer Method 31-114-27-1-D
<b>Generic Instrument Description</b>	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

<b>Dataset-specific Instrument Name</b>	Gravity Core
<b>Generic Instrument Name</b>	Gravity Corer
<b>Generic Instrument Description</b>	The gravity corer allows researchers to sample sediment layers at the bottom of lakes or oceans. The coring device is deployed from the ship and gravity carries it to the seafloor. ( <a href="http://www.whoi.edu/instruments/viewInstrument.do?id=1079">http://www.whoi.edu/instruments/viewInstrument.do?id=1079</a> ).

<b>Dataset-specific Instrument Name</b>	DIONEX ICS-2000
<b>Generic Instrument Name</b>	Ion Chromatograph
<b>Dataset-specific Description</b>	Porewater samples collected for: Anions (Sulfate + Chloride) Analytical Method: Ion Chromatography Instrument: DIONEX ICS-2000 Method Reference: DIONEX Application Note 154: Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column
<b>Generic Instrument Description</b>	Ion chromatography is a form of liquid chromatography that measures concentrations of ionic species by separating them based on their interaction with a resin. Ionic species separate differently depending on species type and size. Ion chromatographs are able to measure concentrations of major anions, such as fluoride, chloride, nitrate, nitrite, and sulfate, as well as major cations such as lithium, sodium, ammonium, potassium, calcium, and magnesium in the parts-per-billion (ppb) range. (from <a href="http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....">http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....</a> )

<b>Dataset-specific Instrument Name</b>	Scintillation Counter
<b>Generic Instrument Name</b>	Liquid Scintillation Counter
<b>Dataset-specific Description</b>	Porewater samples collected for: Anaerobic Methane Oxidation Analytical Method: Sediment incubations with $^{14}\text{CH}_4$ Instrument: Scintillation Counter Method Reference: Orcutt, B., et al. 2005. Molecular biogeochemistry of sulfate reduction, methanogenesis and the anaerobic oxidation of methane at Gulf of Mexico methane seeps. GCA Vol. 69, No. 17, pp. 4267-4281
<b>Generic Instrument Description</b>	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used to quantify the activity of particulate emitting ( $\beta$ and $\alpha$ ) radioactive samples, it can also detect the Auger electrons emitted from $^{51}\text{Cr}$ and $^{125}\text{I}$ samples.

<b>Dataset-specific Instrument Name</b>	Shimadzu TOC-V
<b>Generic Instrument Name</b>	Shimadzu TOC-V Analyzer
<b>Dataset-specific Description</b>	Porewater samples collected for: Dissolved Organic Carbon Analytical Method: High temperature combustion Instrument: Shimadzu TOC-V Method Reference: <a href="http://www.pangaea.de/Projects/JGOFs/Methods/chap16.html">http://www.pangaea.de/Projects/JGOFs/Methods/chap16.html</a>
<b>Generic Instrument Description</b>	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

<b>Dataset-specific Instrument Name</b>	Shimadzu TOC-V with TN Unit
<b>Generic Instrument Name</b>	Shimadzu TOC-V Analyzer
<b>Dataset-specific Description</b>	Porewater samples collected for: Total Dissolved Nitrogen Analytical Method: High temperature combustion/Chemiluminescence Instrument: Shimadzu TOC-V with TN Unit Method Reference: Pan et al., Simultaneous Determination of Dissolved Organic Carbon and Total Dissolved Nitrogen on a Coupled High-Temperature Combustion Total Organic Carbon-Nitrogen Chemiluminescence Detection (HTC TOC-NCD) System. Journal of Automated Methods & Management in Chemistry, 2005 (2005), no. 4, 240-246
<b>Generic Instrument Description</b>	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

<b>Dataset-specific Instrument Name</b>	Shimadzu UV-1601
<b>Generic Instrument Name</b>	UV Spectrophotometer-Shimadzu
<b>Dataset-specific Description</b>	Porewater samples collected for: Total Dissolved Phosphorus and Ammonium Analytical Method: Spectrophotometry Instrument: Shimadzu UV-1601 Method Reference: Solorzano, L., and Sharp, J. H. 1980. Determination of total dissolved phosphorus and particulate phosphorus in natural waters. Limnol. Oceanogr. 25: 754-758. Solorzano, L. 1969. Determination of ammonia in natural waters by the phenolhypochlorite method. Limnol. Oceanogr. 14: 799-801
<b>Generic Instrument Description</b>	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

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## Deployments

### ESAS Fall 2011

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/641549">https://www.bco-dmo.org/deployment/641549</a>
<b>Platform</b>	shoreside East Siberian Arctic Shelf
<b>Start Date</b>	2011-09-01
<b>End Date</b>	2011-10-31
<b>Description</b>	Siberia Cruise Porewater Samples Collected Sept-Oct, 2011

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## Project Information

**Collaborative Research: Degrading offshore permafrost as a source of methane on the East Siberian Arctic Shelf (East Siberian Arctic Shelf)**

**Website:** <http://www.joyeresearchgroup.uga.edu/research/climate-change/arctic-ecosystems/degrading-offshore-permafrost-source-methane>

**Coverage:** East Siberian Arctic Shelf

### **From the NSF Award ABSTRACT**

The Arctic region contains a huge amount of organic carbon, referred to as the Arctic Carbon Hyper Pool, within the Arctic Ocean sedimentary basin. This area has the highest documented rates of coastal sedimentation with annual accumulation rates of about 10 million metric tons organic C per year, which approximately equals the amount of sediment accumulated over the entire pelagic zone of the World Ocean. Due to the specific features of sedimentation and lithogenesis in this area, much of this organic carbon survives decomposition, and is buried within seabed sediments. These sediments are frozen annually or seasonally, representing a substantial reservoir of potentially labile organic carbon. Global warming in the arctic region is predicted to be substantial, and possibly rapid, in next few decades. Upon the melting of permafrost, old stored carbon will be reintroduced into the modern carbon biogeochemical cycle, possibly acting as a strong source of methane to the overlying water and potentially the atmosphere. Additionally, extremely large amounts of more ancient (Pleistocene) methane are trapped as gas hydrates within and beneath the permafrost. This research aims to elucidate the present and future methane flux potential of sediments and permafrost in regions of the East Siberian Arctic Shelf. As a result of global warming, seafloor permafrost along the East Siberian Arctic Shelf may experience a pronounced change in thermal regime. Increased temperature may affect permafrost in several ways, ultimately leading to its degradation and enhanced CH<sub>4</sub> release. An international, interdisciplinary research team will determine the distribution and stability of permafrost on the East Siberian Arctic Shelf and evaluate this area as a methane source to the arctic region. Cores from eleven locations will be obtained using dry drilling techniques. Rates of biological methane production and consumption (oxidation) will be quantified in permafrost and sediments at in situ and elevated temperatures. Natural abundance stable carbon and hydrogen isotope measurements will be used to quantify the age and source of methane collected from different sites and depths. These data will be used as input to numerical models, which will be developed to describe the thermodynamic and biogeochemical aspects of permafrost methane dynamics. Using field data and modeling, the current and future potential release of methane from offshore permafrost will be determined and a methane budget for the East Siberian Arctic Shelf will be constructed.

### **BOOKS/ONE TIME PROCEEDING**

Joye, S.B., V.A. Samarkin, N. Shakova, I.

Semiletov, and M.W. Bowles. "Methane dynamics along the East Siberian Arctic Shelf: sources, sinks, and

fluxes to the atmosphere", 09/01/2011-08/31/2012, "*Gordon Research Conference on Polar Marine Science*", 2011, "2011 GRC-PMC Ventura California".

Finke, N., S. Baer, and S.B. Joye. "Methane production in marine sea ice in the Chukchi Sea, Barrow, Alaska", 09/01/2011-08/31/2012, "*Meeting Abstracts*", 2012, "NASA AbSciCon, Atlanta GA April".

Samarkin, V.A., I. Semiletov, N. Finke, N.

Shakhova, and S. B. Joye. "Methane stable isotope signatures in waters and sediments of the Laptev Sea

Shelf", 09/01/2011-08/31/2012, "*Fall AGU meeting 2012*", 2012, "AGU Meeting Abstracts".

### **Project Summary**

#### **Collaborative Research: Degrading offshore permafrost as a current and potential source of atmospheric methane on the East Siberian Arctic Shelf**

**Intellectual Merit:** The Arctic region contains a huge amount of organic carbon, referred to commonly as the "Arctic Carbon Hyper Pool", within the Arctic Ocean sedimentary basin. The Russian Arctic shelf acts as an estuary of the Great Siberian Rivers. This area has the highest documented rates of coastal sedimentation with annual accumulation rates of about  $10 \times 10^6$  t Corg yr<sup>-1</sup>, which approximately equals the amount of sediment accumulated over the entire pelagic zone of the World Ocean. Due to the specific features of sedimentation and lithogenesis in this area, much of this organic carbon survives decomposition, and is buried within seabed sediments. Some of these sediments are seasonally or annually frozen ("offshore" permafrost), representing a substantial reservoir of old but potentially labile organic carbon. Global warming in the Arctic region is predicted to be substantial, and possibly rapid, in the next few decades. Upon permafrost melting, the old carbon stored

therein will be reintroduced into the modern carbon biogeochemical cycle, possibly acting as a strong source of methane to the overlying water and potentially the atmosphere. Additionally, extremely large amounts of more ancient (Pleistocene) methane are trapped as gas hydrates within and beneath the permafrost. The proposed work aims to elucidate the present and future methane flux potential of sediments and permafrost in regions of the East Siberian Arctic Shelf. As a result of global warming, seafloor permafrost along the East Siberian Arctic Shelf may experience a pronounced change in thermal regime. Increased temperature may affect permafrost in several ways, ultimately leading

to its degradation and enhanced CH<sub>4</sub> release. This international, interdisciplinary research team will determine the distribution and stability of permafrost on the East Siberian Arctic Shelf and evaluate this area as a methane source to the Arctic region. Cores from eleven locations will be obtained using dry drilling techniques. Rates of biological methane production and consumption (oxidation) will be quantified in permafrost and sediments at *in situ* and elevated temperatures.

Natural abundance carbon (<sup>13</sup>C and <sup>14</sup>C) and hydrogen isotope measurements will be used to quantify the age and source of methane collected from different sites and depths. These data will be used as input to numerical models, which will be developed to describe the thermodynamic and biogeochemical aspects of permafrost methane dynamics. Using field data and modeling, the current and future potential release of methane from offshore permafrost will be determined and a methane budget for the East Siberian Arctic Shelf will be constructed.

**Broader impacts:** The proposed work will address a key aspect of the “International Polar Year” request for proposals by advancing the understanding of the coupled physical-geological-biological-chemical system of the Arctic Ocean and providing a predictive model of how the system will respond to environmental change. This work will elucidate the impact of global warming on methane dynamics in the Arctic; in particular, the current and potential capacity of sediments and permafrost to act as a methane source to the overlying water column and atmosphere will be quantified. The scientific team includes PIs with experience working in the Arctic (Semiletov, Shakova, Samarkin) as well as PIs new to this area (Joye, Meile). International collaborators (Grigoriev, Rekant, Kholodov) complete the research team by providing extensive expertise in geology and permafrost drilling in the Arctic. Besides supplying crucial data on CH<sub>4</sub> fluxes to global change scientists, this proposal will promote training by supporting students at various levels and by reaching the public and interested scientists through a dedicated website. The project will contribute to the active outreach activities coordinated through the multi-agency Northern Eurasia Earth Science Partnership Initiative (NEESPI). This proposal will also contribute to the collaboration between two major Arctic nations, the United States and Russian Federation. All data generated during this project will be submitted to the BCO-DMO database.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Polar Programs (NSF PLR)</a>	<a href="#">PLR-0908788</a>

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