CruiseTrackBH13-13

Website: https://www.bco-dmo.org/dataset/657684
Data Type: Other Field Results
Version:
Version Date: 2016-08-26

Project
» Sources and Sinks of Stoichiometrically Imbalanced Nitrate in the Laurentian Great Lakes (SINC)

Program
» Laurentian Great Lakes Ecosystem Studies (Laurentian Great Lakes Ecosystem Studies)

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Dataset Description

testing

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Data Files

File
ControlNav.csv (Comma Separated Values (.csv), 3.47 KB) MD5:4e145973de07232402648e9765ee2483 Primary data file for dataset ID 657684

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Parameters

Parameters for this dataset have not yet been identified

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Deployments

BH13-13

Website	https://www.bco-dmo.org/deployment/657333
Platform	R/V Blue Heron
Start Date	2012-06-20
End Date	2012-07-01
Description	testing

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Project Information

Sources and Sinks of Stoichiometrically Imbalanced Nitrate in the Laurentian Great Lakes (SINC)

Website: http://www.tc.umn.edu/~stern007/

Coverage: Lake Superior; Great Lakes

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

Over large scales encompassing heterogeneous conditions, biogeochemical mechanisms act to achieve a stoichiometric balance between nitrogen and phosphorus. Locally, however, imbalances can develop. The Laurentian Great Lakes are a vast freshwater system where nitrate has been steadily accumulating for decades. Previous work has shown that in Lake Superior, the headwaters of the system, nitrate enters the lake water primarily due to in-lake biogeochemical processes, not due to passive accumulation of nitrate as a conservative substance as previously believed. An extreme stoichiometric imbalance of nitrate/phosphate ratios (~ 10,000 by moles) is present and is apparently growing. This set of prior findings opens up two major questions. First, what are the principal biogeochemical control points that tip the N cycle toward buildup of excess nitrate? And second, how does the extreme stoichiometric imbalance affect the ecology and evolution of Lake Superior's biota?

In this project, researchers at the University of Minnesota - Twin Cities and the Bowling Green State University, who previously documented the nitrate buildup in Lake Superior, will continue their research program and address these two questions. The project is organized around making comparative measurements of N assimilation, nitrification, denitrification, anammox, and microbial community structure in Lake Superior and in the central basin of Lake Erie. These two environments differ greatly in many ways including redox state and organic carbon production rates. From the standpoint of N balancing mechanisms, they can be considered end members within the Laurentian Great Lakes. Additional data will be collected across a larger region of the Upper Great Lakes including Lake Huron. Up-to-date mass balance budgets of nitrogen of the most of the Great Lakes (Lake Superior is already done) will be constructed and linked with hydrologic fluxes to gain insights into the dynamics of N across the entire Laurentian Great Lakes System. Observations of water chemistry will be made with ship-board sampling together with field-deployed nitrate sensors in shallow and deep waters. Process studies will be performed in the water column and at the sediment-water interface and will involve sensitive stable isotope techniques. These will include measurements of NO3 and NH4+ uptake into different size fractions, exchanges of different forms of N and C between the water column and sediments, nitrification, denitrification, and anammox. The diversity and abundance of ammonia oxidizing Archea (AOA) and bacteria (AOB) will be studied using quantitative real time PCR and DGGE. Similarly, the genetic composition of denitrifyers and anammox bacteria will be studied to see if they too are represented by novel clades in Lake Superior. Cultured nitrifyers will be characterized in terms of growth under different conditions typically encountered across the Great Lakes. The project will yield valuable information and insight into the operation of the nitrogen cycle under conditions that promote stoichiometric imbalances.

Previous work (2004-2007) by this team of investigators and others investigated the intersection of the nitrogen cycle with the phosphorus and iron cycles in Lake Superior and included studying the responses of plankton communities to differing nutrient supply regimes. Prior to 2004, many of the same investigators conducted research on the existence, mechanisms, spatial-temporal extent, and significance of trace metal limitation to primary production in Lake Superior. This early research was designed to quantify and characterize total and bioactive trace metal concentrations of Al, Fe, Mn, Zn, Cu, Cd, and Co in Lake Superior. The project

included immunological and fluorescence assays to assess metal deficiency in algae in the natural environment and trace metal enrichment experiments in the laboratory to assess limitation experimentally.

The Laurentian Great Lakes are a valuable regional resource and an immense reservoir of planetary fresh water. Lake Superior is often considered to be relatively pristine but the ultimate source of the N converted to nitrate in the lake is as yet unknown and may involve past changes to the watershed or other anthropogenic factors.

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Program Information

Laurentian Great Lakes Ecosystem Studies (Laurentian Great Lakes Ecosystem Studies)

Website: http://www.tc.umn.edu/~stern007/

Coverage: Laurentian Great Lakes

A series of studies concerned with the chemistry and biology of the Laurentian Great Lakes. These different studies share a focus on the dynamics of organic pools of carbon, nitrogen and phosphorus, and the stoichiometric linkages among these elements. At different times, work also has focused on trace metal dynamics and interactions with biota, the rates of primary production and herbivory, rates and patterns of primary productivity, and the century-long, steady trend of increasing nitrate in Earth's largest lake by area. Microbial populations have been investigated and linked to these chemical properties.

This Program was created by BCO-DMO staff to bring various Laurentian Great Lakes Research projects under one umbrella for improved discovery and access.

Dates: 1998 - 2014
Funding: NSF/OCE and Minnesota Sea Grant

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