Synopsis
SINC 10, Aug. 18-20

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Environmental conditions

Start of the cruise was delayed ~ 1d due to big waves in open water. The first day was overcast and stormy to the southeast, with gradual clearing. The second day was clear, warm and sunny. Light winds and calm conditions prevailed until the second night of the cruise, when a second weather front moved in, resulting in a session of rough water, thunder storms and rain through the night. Some late night heroics by Small, Scott, and Brovold to complete sample processing during rough seas. The final day overcast, but the water was not as rough as forecast. CD-1 showed signs of thermocline erosion (5C in the epiliminion) and WM had cooled down to ~15C from apparently warmer temperatures the previous week.

Water chemistry

CD-1, mid-day Aug. 18. Surface temperature = ~5C! Sampled depths (2, 5, 15, 20, 30, 100, 150, 246m) for standard water chemistry parameters.

WM, mid-day Aug 19 Surface temperature = ~14.8C. Sampled modified in situ bottle array depths (2, 5, 10, 20, 30, 40, 60, 90, 120, 160m). High resolution depth sampling done for NO3, NH4, TDP, and chlorophyll by addition of depths (1, 3, 8, 14, 18, 23, 25, 35, 45, 50, 55, 65, 70, 80, 100, 110, 130, 140, 150, 160).

CTD cast also done at STE-C.

^{14}C production, nitrification.

At site WM did standard, JGOFS based primary production in situ array with modified depths and bottle numbers. Began at water collection at 11:30 and bottles were in the lake by 0400. Nitrification using Hicks method done at all depths.

^{15}N nitrification measurements

Two bottles per depth in bottle array using same procedure as previous array experiments using 250uL of 40uM Ammonium 15N Chloride stock per bottle. We also added two light bottles with 15N-NH4 (in addition to the standard two dark bottles) in cages at depths 2, 5, 10, 20, 30, 40, 60 m to test for a decrease in nitrification rates when algae are competing for NH4.

On deck experiment done to examine nitrification response to NH4 concentration gradient for two depths (epi and hypolimnion) and 8 concentrations of NH4 ranging from X to Y.

Bottom sampling

Multicore used at CD-1, WM, and STE-C. Six cores (2 per site) given to Katsev for oxygen profiling. Six other cores will be incubated for MIMS at St. Paul using new core tops.

Surficial sediments collected at multicore sites (above) plus FWM/Grab 7, Grab 6 from previous cruise, plus a new site between CD1 and WM (Grab 11), and two new sites south of WM (Grab 9, 10). Effort focused on deepwater, and repeat sampling of Grab 3-6 was not possible due to logistics and weather (i.e. intense lightning through the Apostle Islands). Two separate grab samples were collected at each site to gain more information about spatial heterogeneity in denitrification. Samples processed in St. Paul on Saturday.

Genetics

Samples from nucleic acid extraction were collected from near-surface and near-bottom depths at WM (10 liters filtered from 5m and 4 liters from 155m). Samples were flash-frozen in liquid nitrogen before transport back to Bowling Green.

Copper chelation experiments

Two experiments were conducted to test the effects of copper chelation on nitrification and prokaryotic growth. Near-surface (5m) and near-bottom (155m at WM) whole water samples were aliquoted into triplicate 250 mL bottles, spiked with $^{15}N\text{-}NH_4$ as per the standard nitrification protocol, and treated with 0nM, 5 nM, 20 nM and 100 nM Cyclam. The gradient of Cyclam concentrations was used here in order to see the effect of titrating the free Cu concentration (ambient is ~ 12 nM). A second experiment was conducted on whole water collected at 155m water from WM then aged with the gradient of Cyclam concentrations for 12h before initiating the experiment with the ^{15}N spike.

Fluorescence *in situ* hybridization

Whole water samples from FISH analysis were prepared from eight depths at CD-1(2, 8, 15, 35, 100, 150 and 244m) depths. Water overlying sediment cores were similarly fixed. Samples were fixed with formaldehyde and mounted onto black 0.2 µm polycarbonate filters and frozen from transport back to Bowling Green. Water was collected from ten depths at WM (2, 5, 10, 20, 30, 40, 60, 90, 120, 155 m) for fixation and filtration back at Bowling Green.

Microplankton enumeration

The abundance and biomass of microplankton was measured to evaluate the possible role growth and grazing may have on nutrient cycling in the water column of Lake Superior. Samples were collected from the routine depth distribution profiles at both offshore sites in the lake (8 depths at CD-1, and 10 depths at WM). Subsamples were drawn from Niskin bottles and subsequently preserved with glutaraldehype (final conc 1%) for pico/nanoplankton and microplankton enumeration (both hetero- and autotrophs). These

samples were immediately refrigerated, and microscope slides were prepared on shipboard within 24-hour of collection (Carrick and Schelske 1997).

Grazing experiments
Whole water (6L each sample) drawn from CD-1 and WM at surface (5m), metalimnion (DCM) and at depth (244 m at CD-1 and 155 m at WM) for grazing experiments by Hunter Carrick. Water shipped to Penn State by UPS.

Flow cytometry
Triplicate samples from eight depths at CD-1 (2, 8, 15, 35, 60, 100, 150, 244 m) preserved for flow cytometry (150 uL 10% formaldehyde added to 1350 uL water, incubated in dark 30 minutes, frozen in LN2)

Triplicate samples* from 25 depths (1, 5, 8, 10, 14, 18, 20, 23, 25, 30, 33, 40, 45, 50, 55, 60, 65, 70, 80, 90, 100, 120, 130, 150 and 155 m) preserved for flow cytometry and frozen in liquid nitrogen

> ***Note:** Duplicates only for 23, 25 and 33 m due to space limitation in shipping Dewars*