SPRING 2016 SEMINAR SERIES

DEPARTMENT OF OCEAN, EARTH, AND ATMOSPHERIC SCIENCES
3PM – ROOM 200 IN THE OCEANOGRAPHY/PHYSICS BUILDING
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"Nitrogen isotopic evidence for a shift from nitrate- to diazotroph-fueled export production in large-volume mesocosm experiments", also known as, "Novel observations that may reconcile prior conflicting models of the fate of newly fixed nitrogen in the ocean"

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ABSTRACT

In a shallow, coastal lagoon off the southwest coast of New Caledonia, large-volume (~50 m^3) mesocosm experiments were undertaken to track the fate of newly fixed nitrogen (N). The mesocosms were intentionally fertilized with 0.8 µM dissolved inorganic phosphorus (DIP) to stimulate diazotrophy (N_2 fixation). N isotopic evidence indicates that the dominant source of N fueling export production shifted from subsurface nitrate (NO_3^-) assimilated prior to the start of the 23-day experiments to N_2 fixation by the end of the experiments. While the δ15N of the sinking particulate N (PN_{sink}) flux changed during the experiments, the δ15N of the suspended PN (PN_{susp}) and dissolved organic N (DON) pools did not. In spite of the absence of detectable NO_3^- in the mesocosms, the δ15N of PN_{sink} indicated that NO_3^- continued to fuel a significant fraction of export production (20 to 60%) throughout the 23-day experiments, with N_2 fixation dominating export after about two weeks. Concurrent molecular and taxonomic data showed large shifts in both the diatom and diazotroph communities throughout the experiment, which were associated with dramatic shifts in the rates of N_2 fixation, primary productivity, and export production. The unicellular cyanobacterial diazotroph, a *Cyanothece*-like UCYN-C, proliferated during the last phase of the experiments when N_2 fixation, primary production, and the flux of PN_{sink} increased significantly, and δ15N budgets reflected a predominantly diazotrophic source of N fueling export production. At this time, the export flux itself was likely dominated by the non-diazotroph associated diatom, *Cylindrotheca closterium*, along with a lesser contribution from other eukaryotic phytoplankton, and a small contribution (<10%) from aggregated UCYN-C cells. Despite comprising a small fraction of the total biomass, UCYN-C was largely responsible for driving export production during the last ~10 days of the experiments through the rapid transfer of its newly

fixed N to other phytoplankton; we infer that this newly fixed N was transferred through the DON and/or ammonium pools. This inference reconciles previous observations of invariant oligotrophic surface ocean DON concentrations and δ15N with incubation studies showing that diazotrophs can release a significant fraction of their newly fixed N as some form of DON.

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