

Carbon Cycle Dynamics on the Atlantic Continental Margin

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What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

Our primary question was: How does gross primary production (the total photosynthetic flux) and net community production (the net amount of CO₂ drawn down by the biological pump) change as one goes from productive, shallow open waters across the continental shelf to deep open ocean waters?

What have you discovered or learned that you didn't know before you started this work?

We found that net community production decreases as one goes across the shelf. This means that the waters closer to the coast export, or “pump”, more CO₂ into the deep ocean, than the waters farther from the shore. Also, the net to gross production ratio decreases as one goes across the shelf. This means that the waters closer to the coast are less efficient at recycling carbon in the surface ocean and that they export a higher percentage of the productivity. Surprisingly, we found that gross primary production does not show a consistent relationship across the shelf.

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

We found that net community production and gross primary production are decoupled - i.e. they do not respond to the transition from shelf waters to open ocean in the same way. This is significant because it means the processes controlling the two types of biological production are different and that they may respond differently as climate changes.

What is the significance of this research for society?

Net community production is one of the two mechanisms by which the ocean takes up anthropogenic CO₂. Thus a better understanding of variability in net community production and the mechanistic controls on net community production are important for predicting future ocean uptake of CO₂.

What were the most unusual or unexpected results and opportunities in this investigation?

The most unexpected result was that gross primary production did not show a consistent trend as one crossed from the coastal waters to the open ocean. Since coastal waters are more productive in terms of net community and net primary productivity, we fully expected them to have higher gross production as well.

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

This work was conducted on the Eastern Continental Shelf in September and October of 2010 on three transects from inshore waters (water depth approximately 1000m) to open ocean waters (water depth 4500 m). One transect was off Nova Scotia, the other off of Woods Hole, and the final one off of Cape Hatteras. Samples were collected aboard the R/V Atlantis and were analyzed in Stanley's lab at WHOI.

What were the key tools or instruments you used to conduct this research?

We used gas tracers as "geochemical tools" to quantify net community and gross primary production. In particular, the ratio of oxygen to argon constrained net community production. The triple isotopic composition of oxygen constrained gross primary production. By using these geochemical tools we were able to quantify rates of production on a broader scale than is done by more traditional techniques.

Is this research part of a larger project or program?

We conducted this research on a NSF-funded cruise that aimed at understanding deep carbon transport from the coastal waters to the interior ocean. Our work showed that the carbon flux from the surface (what we measured) is too small to support the carbon being collected in deep sediment traps (the latter part was done by other scientists on the cruise), confirming the hypothesis that carbon is being transported off the shelf at depths > 1000 m.

What are your next steps?

We have written a proposal to NASA requesting funding to develop algorithms from remotely sensed data (i.e. satellite data) that could predict rates of net community and gross primary production across the shelf. As part of that proposal, we hope to return to one of the transects and this time also measure optics data.

Have you published findings or web pages related to this research? Please provide a citation, reprint, and web link (when available).

Publications from this work are in preparation.