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Discussions

Interactive comment on "Sargasso Sea phosphorus biogeochemistry: an important role for dissolved organic phosphorus (DOP)" *by* M. W. Lomas et al.

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This work presents a large set of data on the P cycle at the BATS station, in particular focusing on the importance of the largest pool, the DOP. A main conclusion is that this pool plays an active role in the P-cycle, not only in the photic zone but also in the export – import budget. The large dominance of the DOP pool in the upper water column seems to be a common characteristic of the P-stressed oligotrophic marine regions. Even a small turnover-time for this dominant pool may therefore contribute extensively to the P-flux through the much smaller pool of P in the biota. I therefore

consider this an important piece of work.

I have only some minor comments and questions: 1: The conclusion that biological production occurs at Redfield ratio is based on regression lines such as those in Fig.7. I cannot find a description of whether these regressions are Type I and Type II. I suspect they may be Type I, but believe they should be Type II since there presumably is error in both X and Y. If the regressions are Type I, does it affect the conclusions if the regressions are changed to Type II?

The regressions were actually Type II. This has been explicitly stated in the text to eliminate this confusion. In answer to the question "does it affect the conclusions", no running Type I or Type II regression on this particular dataset results in the same conclusion.

2: There is very little description in the M&M on how blanks were made for the different analyses of phosphate. I thought this was one of the problems with the nanomolar measurements of phosphate and a more detailed description therefore warranted.

We have included in the revision more details on the reagent blanks and their values relative to the calculated sample values for each of the analyses.

For example, the MM section for MAGIC-SRP now reads "…Samples were calculated against a potassium monobasic phosphate standard, made up in phosphate free seawater following subtraction of an analytical blank, and the accuracy of this standard checked on each run with a certified standard (Ocean Scientific International Ltd. Phosphate Nutrient Standard Solution). With every daily analytical run, aged surface Sargasso Sea water was treated with NaOH addition as above and the supernatant, now free of SRP, was used to make the analytical blank for the each run by adding all reagents as described above. The analytical blank had an absolute absorbance that was always < 2 nmol l-1 standard (lowest used in the standard curve), and generally had a calculated value of $\leq$ 1 nmol l-1. The method detection limit following this protocol is $\sim$1-2 nmol l-1 (conservatively defined as 3x the std dev. of the 2 nmol l-1 standard, and higher than the calculated reagent blank) with a precision of + 5% at 5 nmol l-1. MAGIC-SRP concentrations compare favorably with BATS autoanalyzer SRP concentrations (MAGIC-SRP = 1.01 x Autoanalyzer – 17.3 nmol l-1). " Similar corrections have been made to the other sections and we hope the reviewer finds them clear and appropriate.

3. It is stated that: "The similarity in seasonal and depth distributions for [PPhos] and whole-community APA suggests that much of the measured whole-community APA is associated with particles and not in solution". They way I read this, I do not see the necessity in the logic. Could you not get a lot of free APA in combination with a good correlation between particulate-P and APA if organisms release all the AP produced into the water, but the life-time of free AP molecules is short compared to the mixing processes of the water?

After re-reading this section, we see how it can be mis-interpreted. The sentence following the one in question says that we didn't see substantial APA in the <0.2um fraction (ie., dissolved activity was low). We have now combined the two sentences to make it clearer that dissolved APA is low and most of the APA appears particle associated.

4. The DOP concentrations are low at the deep (500 m) measured, particularly in winter-spring. To me this seems like another good argument for the degradability of the DOP, at least over seasonal time scales. I could not find this argument being used by the authors, and if I have not just missed a point here, I would like to know why the authors have chosen not to use this?

We didn't make this point because we honestly weren't thinking that way, but the reviewer is absolutely correct, the decrease in DOP with depth may speak to its degradability. While we could include a discussion of this pattern, a detailed discussion might be misleading for the following reason. The shallow (<1000m) water column at BATS is comprised of several interleaved water masses, most notably the Subtropical Mode

Water (STMW). The STMW does not comprise a constant depth range and covers most of the distance between 200-500m (Figure 1a below). This water mass forms at the surface to the north of BATS (Figure 1b) and thus is impacted by non-local (local to BATS) surface processes (see Palter et al. 2005). At the current time we don't know what the DOP concentrations are in the STMW at the site of formation and as that water mass advects southward. We know that surface concentrations north of BATS are higher, but not concentrations in the STMW. So while the lower concentrations at >200m might suggest microbial degradation of DOP, water mass issues need to be considered. The concentrations of DOP below 200m at BATS, 20-40 nmol/L are similar, 30-50nmol/L, to the surface concentrations of DOP seen at 36N/64W (Torres-Valdes et al. 2009).

In an effort to conservatively address this comment we have modified the following paragraph in the revised paper discussion.

"Something that has not been considered in previous phosphorus budgets are vertical inputs of DOP. [DOP] are measurable between 100 – 200 m, but there is a decreasing gradient in the profiles, so vertical fluxes should be minimal. Indeed, the decrease in DOP with depths between 200-500m may be indicative of net consumption. However, the subtropical mode water, a water mass formed at the surface to the north of BATS and then subducted southward, spans most of this depth range and the low concentrations could be indicative of this different water mass (see DOP data in Torres-Vlades et al. 2009). Overall, these results highlight an imbalance in phosphorus demand and vertical supply that is further exacerbated after accounting for export fluxes."

Interactive comment on Biogeosciences Discuss., 6, 10137, 2009.

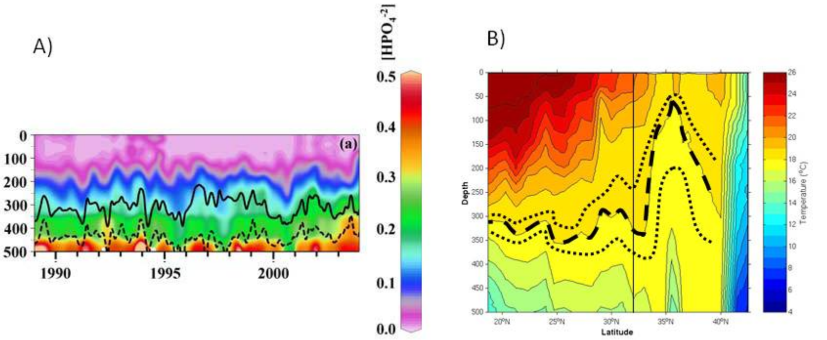

Figure 1a. Time series of [HPO42 in the upper 500 m at the Bermuda Atlantic Time-series Study (BATS) site from 1989 to 2003 (units in umol/L). Black lines represent surfaces of (solid) 26.4 kg/m3 and (dotted) 26.5 kg/m3 and define the approximate upper and lower bounds of STMW.

Figure 1b. Transect of ocean temperature in the western North Atlantic passing through BATS (vertical solid line). The dotted lines show the upper and lower boundaries of the STMW and show that it approaches the surface north of BATS.

Fig. 1.