Biogeosciences Discuss., 4, S1419–S1425, 2007
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Biogeosciences Discussions

Interactive comment on "Phosphate availability and the ultimate control of new nitrogen input by nitrogen fixation in the tropical Pacific Ocean" *by* T. Moutin et al.

Anonymous Referee #1

Received and published: 21 September 2007

While this paper contains important interesting information I can't recommend it for publication in its current form. Overall, this paper needs more work. Some sections need to be rewritten because the text is not clear. The P pool is very well characterised. Nevertheless, the paper suffers of a lack of N2 fixation data.

Abstract :

The abstract needs to be improved. P data are not clearly linked to N2 fixation data. Some results do not appear in the abstract such as : there is no P limitation of N2 fixation in the south east Pacific ocean, temperature is probably a key factor in N2 fixation control in this area. . .

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Lines 5 and 8 replace phosphate by phosphorus

Line 11: . . . remained above 100 nM in the upper layer (0-200m)

and TDIP were more than 6 months (min value ∼200 day fig. 2e and 3h)

line 15: . . . during the summer season in the upper layer

Introduction :

Page 2409

Line 7 : Karl et al., 2007 is not in the list of references

Line 4 to 9: the sentence is too long. Need to clarify in the text that the increase of N2 fixation rate with pCO2 is based only on culture experiments of Trichodesmium (see also Hutchins et al., 2007)

Line 10 : add : changes in atmospheric Fe inputs (Tagliablue et al., 2007, Biogeosciences discuss.,)

Line 12 : "an increase in diazotrophic populations" : does it mean an increase of biomass or diazotrophic species number ? please clarify it

Line 20 : While the atmospheric source of P is probably low it is definitely not zero as suggested in the text

Page 2410

line 1 : . . . add : N2 fixation rate

Line 16 : the reference Levitan et al 2007 is not correct

Method :

Page 2411 : N2 fixation

Only 0.6 L was incubated for N2 fixation rate. 2 to 4 L are generally needed in olig-

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otrophic areas to measure N2 fixation rate (15N2), e.g. Needoba et al., 2007 L&O. Therefore, I am really surprised that the authors can measure significant N2 fixation rate with a so small volume. Please comment

24h incubation time : The Montoya 15N2 method of measuring nitrogen fixation has the advantage of using the actual substrate for the nitrogenase enzyme, rather than an analogue as in the acetylene reduction assay. It also has a number of serious drawbacks. The most serious is that much of the nitrogen fixed by diazotroph is released as ammonium or DON on very short timescales, so it typically results in an underestimate of nitrogen fixation. New data suggests that as much as 20-80% of fixed nitrogen can be released over the course of a short incubation. This would of course lead to large underestimates of nitrogen fixation in this experiment. Was any attempt made to quantify DON or DIN release? Comment.

Please detail in the text if you made duplicates

Line 19 : What samples (i.e. what type and weight) did you used for the determination of background natural abundance ?

Page 2412 : P pools

DIP : please detail in the text if you made duplicates for DIP measurements and provide the standard deviation

PP : Detail in the text if you made duplicates. What is the detection limit for PP ? 20 nmol L-1 ? what is the pressure of filtration ?

DOP : please detail in the text if you made duplicates and provide the uncertainty of DOP estimates

Page 2413 : TDIP

please detail in the text if you made duplicates and provide the standard deviation

Page 2414 :

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Pressure of 0.6 bars : this high filtration pressure could potentially damage cells leading an eventual release of 33P in the dissolved phase. A consequence of this would be an underestimation of radioactivity on the filter. Comment.

Have you withdrawn the blanks from samples counts ? what is the mean and maximum blank values (percentage of the radioactivity in the samples) ?

Line 11 : could you please add a reference for P monoesters ?

Labile DOP : please detail in the text if you made duplicates and provide the uncertainty

Page 2415:

Line 3 : Clarify what is P*

Result

Page 2415

Line13 : Do chlA values confirm the low biomass estimated with PP ?

Line18-19 : the detection limit for labile DOP is 20 nM, please clarify then how you could give 4.7 nM of labile DOP ?

Please include in the text the labile DOP data. Are they all below detection limit ? what is the spatial distribution of this parameter ? Comment

Line 23 : undetectable ($<$ 3 nmol L-1)

Page 2416 :

Please include the mixed layer depth data and alsothe max chlA depth

Could you explain the variability of DIP measurements at 250m (fig 3e)? please comment

Line 5 :3.5 μmol.m-4 ?check units

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Line 17 : if the PP detection limit is 20 nmol L-1, please clarify then how you could give 9.3 nmol L-1

Line 19 : same remark for 1 nmol L-1

Page 2416-17-3.1.3

Please add that in the upper layer, the maximum values of DIP (and for TDIP) are recorded at S-gyre station when compared to the other stations.

At the SW station during summer, how do you explain the DIP decrease and the “no variation” of DOP and PP ?

Please compare PP concentrations at S-gyre and N-gyre stations with those at SW

Line 15 : add : near the sea surface at N-gyre station

Page 2417 3.2

N2 fixation is a central parameter in this paper. However, the paper suffers of a lack of N2 fixation rate data. The three profiles (1 Chilean coast station and 2 S-gyre station) would provide very useful and necessary data. Please, include this new figure. If the same data are available for SW and N-gyre, please include them also.

Bonnet et al., 2007, Biogeosciences were unable to measure nitrogen fixation rate in their experiments with the same protocol used in this paper, even after iron and/or phosphate additions. Please discuss

Please, explain the large observed variability in the N2 fixation flux at the S-gyre station: 48 and 135 μmol N m-2 d-1 at the S-gyre station ?

line 19 : add : in surface waters

line 20 : Please include the data for the Marquesas islands station and depth

line 21: what depth ?

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line 23 : Is 40m the mixed layer depth at Chilean coast station?

Line 24 : Is 200m the mixed layer depth at the S-gyre station ?

Line 25 : low N/P, provide values

Line 26 : “ample Fe concentrations are found”. . . please include the values and the associated reference(s)

Page 2418 : I agree with the light control of the N2 fixation flux. Nevertheless, iron bioavailability can also be a control factor.

Karl et al., 1992 and 2007 are not in the list of references

Could please compare your data with those found in other publications like Needoba et al., 2007, Falcon et al., 2004.

Page 2419

I did not find Raimbault and Garcia, 2007. I found Raimbault et al., 2007. Is it the same paper ?

Page 2420 :

No Trichodesmium were recorded in the study area. Precise in the text that Bonnet et al., 2007 found the presence of extremely low numbers of Group A cyanobacterial phylotypes (see Table 2 in this paper).

Page 2423 - temperature

Could you please add the ODV map of temperature.

Line 18 : I do not agree with your sentence “temperature does not restrict diazotroph growth”. Breitbarth et al., 2007 have shown an effect of temperature on growth rate and nitrogen fixation rate of Trichodesmium.

In the abstract, it is written “During the BIOSOPE cruise, N2 fixation rates were higher

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within the cold water upwelling near the Chilean coast." Could you please provide the temperature data in this area. How do you explain this high flux within the cold water upwelling? Comment

Line 25 : Paerl, 1994 is not in the list of references

Page 2425 :

Line 18: Have you made a statistical test to compare P* and N2 fixation rate?

Page 2427 :

Please add a reference for Mediterranean sea

Figures

Figure 1 :

Increase red line thickness. Please, use another color for Aloha and SW stations which are not part of the BIOSOPE cruise.

Figure 2 :

Change the scale for nitrate concentration because it is very difficult to see any changes especially in the center of the gyre. Are you sure that the units of nitrate concentration are expressed in μM ?

Figure 3 :

Could you include the references for Aloha and SW data ?

Fig e : +S&P, $^{\circ}$ magic : not clear

Table :

Table 1 : Please provide the references for Aloha and SW data ?

Interactive comment on Biogeosciences Discuss., 4, 2407, 2007.