

## ***Interactive comment on “Biotic stoichiometric controls on the deep ocean N:P ratio” by T. M. Lenton and C. A. Klausmeier***

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Cullen (1999) and Tyrrell (1999b) address the ratio of N:P in the surface ocean, not in the deep ocean, which is the focus of our paper. Tyrrell (1999a,b) makes the simplifying assumption that the Michaelis-Menten half-saturation constant for a nutrient ( $N_H$  or  $P_H$ ) is roughly proportional to the rate at which it needs to be taken up to fuel new growth, and therefore the ratio  $N_H:P_H$  is approximately the N:P of non-fixer biomass. Although  $N_H$  and  $P_H$  appear in Tyrrell's equation for the deep ocean N:P ratio ( $R_d$ ) they are not the dominant terms. Rewriting our Eq.(37) to include them explicitly the deep ocean N:P ratio becomes:

$$\frac{NO_3}{PO_4} = \frac{(r_{N:P} \times 1.475 \times 10^{-3}) + (4 \times N_H)}{(1.6 \times 10^{-3}) + (5 \times P_H)} \quad (1)$$

where default values are  $N_H=0.5 \times 10^{-3} \text{ mol N m}^{-3}$  and  $P_H=0.03 \times 10^{-3} \text{ mol P m}^{-3}$ , i.e.  $N_H:P_H=16.7$ . Eq.(1) describes a straight-line relation between the N:P of the plankton ( $r_{N:P}$ , default value 16) and the N:P of the deep ocean. Varying  $N_H$  affects the intercept of the line, whereas varying  $P_H$  alters its gradient as well as the intercept. Neither parameter alters the existence of a direct relationship between  $r_{N:P}$  and deep ocean N:P. Setting  $P_H=0.05 \times 10^{-3} \text{ mol P m}^{-3}$ , which is the alternative value given by Tyrrell (1999a), reduces the gradient of the line to 0.8 (from 0.84) and reduces the intercept to 1.08 (from 1.14). Setting  $N_H=0.1 \times 10^{-3} \text{ mol N m}^{-3}$  (the lower value given by Tyrrell) reduces the intercept to 0.23, whereas setting  $N_H=4.2 \times 10^{-3} \text{ mol N m}^{-3}$  (the upper value given by Tyrrell) increases the intercept to 9.6. Only in the latter case is there a systematic shift in deep ocean N:P. However, the direct relation between  $r_{N:P}$  and deep ocean N:P still exists.

#### References:

Cullen, J.J.: Iron, nitrogen and phosphorus in the ocean, *Nature*, 402, 372, 1999.

Tyrrell, T.: The relative influences of nitrogen and phosphorus on oceanic primary production, *Nature*, 400, 525-531, 1999a.

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