



# Characterizing dissolved organic nitrogen released by marine nitrogen fixers

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## OBSERVATION:

Marine nitrogen fixers (“diazotrophs”) have been shown in manipulative experiments to release a large fraction of their newly fixed nitrogen as some form of dissolved organic nitrogen (“DON”) (Capone et al., 1994; Glibert and Bronk, 1994).

## HYPOTHESES

-Since  $N_2$  fixation has a nitrogen isotopic composition (“ $\delta^{15}N$ ”) that is distinct (-1‰) from the other dominant source of new nitrogen to phytoplankton, subsurface  $NO_3^-$ , ( $\delta^{15}N \sim 5‰$ ), high rates of  $N_2$  fixation will manifest as DON with a  $\delta^{15}N$  closer to the  $N_2$  fixation source than that of subsurface  $NO_3^-$ .

-When  $N_2$  fixation rates are high, DON concentration will be high and DON  $\delta^{15}N$  will be low.

## METHODS

Field samples were collected on five cruises to the subtropical and tropical ocean (Fig. 1) where in situ  $N_2$  fixation rates were measured at the same time that samples were collected for DON concentration and  $\delta^{15}N$ .  $N_2$  fixation rates were determined using the  $^{15}N_2$  incubation method of Montoya et al. (1996), and DON concentration and  $\delta^{15}N$  was measured as described in Knapp et al. (2005).

## RESULTS

-No anti-correlation between DON concentration and DON  $\delta^{15}N$  was observed (Figure 2).

-No positive correlation between  $N_2$  fixation rate and DON concentration was observed (Figure 3b)

-No anti-correlation between  $N_2$  fixation rate and DON  $\delta^{15}N$  was observed (Figure 3a).

-High  $N_2$  fixation rates do not necessarily result in large fluxes to the DON pool

## FUTURE WORK

-Collect samples in the Gulf of Mexico, where previously high diazotroph abundance has correlated with high DON concentrations

-Perform experimental manipulations of diazotrophs in the lab to induce DON production

-Chemically characterize DON produced by diazotrophs at the MagLab

## REFERENCES

- Capone, D.G. et al. (1994), *Appl. Environ. Microbiol.*, 60, 3989-3995.  
 Capone, D.G. et al. (2005), *Global Biogeochem. Cycles*, 19, GB2024, doi:10.1029/2004GB002331.  
 Garcia, H.E. et al. (2006), *World Ocean Atlas 2005*, vol. 4, *Nutrients (Phosphate, Nitrate, Silicate)*, NOAA Atlas NESDIS, vol. 64, Edited by S. Levitus, 396 pp., NOAA.  
 Glibert, P.M., and D.A. Bronk (1994), *Appl. Environ. Microbiol.*, 60, 3996-4000.  
 Knapp, A.N. et al. (2005), *Global Biogeochem. Cycles*, 19, GB1018, doi:10.1029/2004GB002320.  
 Knapp, A.N. et al. (2011), *Global Biogeochem. Cycles*, 25, GB4004, doi:10.1029/2010GB003878.  
 Montoya, J.P. et al. (1996), *App. And Env. Microbio.*, 62, 986-993.  
 Sohm, J.A. et al. (2011), *J. Geophys. Res.*, 116, G03002, doi:10.1029/2010JG001513.

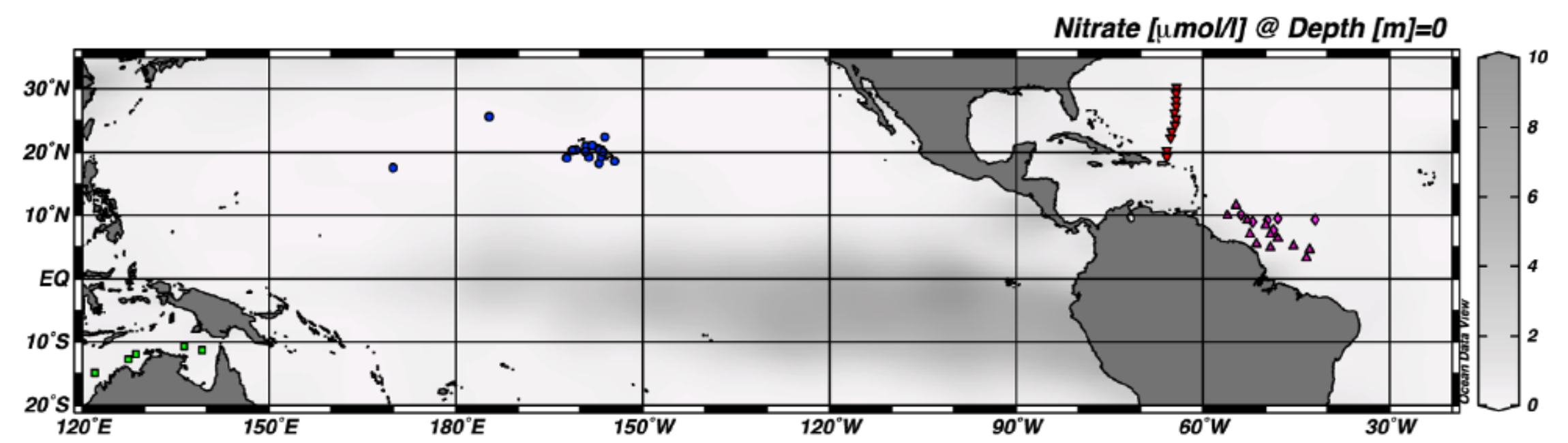


Figure 1. Cruise and station map overlaid upon World Ocean Atlas 2005 (Garcia et al., 2006) annually averaged surface ocean nitrate concentration. Samples were collected in November 1999 on the North Australian shelf (filled green squares); in January-February 2001 and July-August 2001 in the Central Western Atlantic (“MPI”, pink diamonds, and “MP3”, purple triangles, respectively); in October, 2002 in the Sargasso Sea (BVAL 32) (filled red inverted triangles); and in July-August 2003 in the North Pacific (MP9) (filled blue circles). From Knapp et al. (2011).

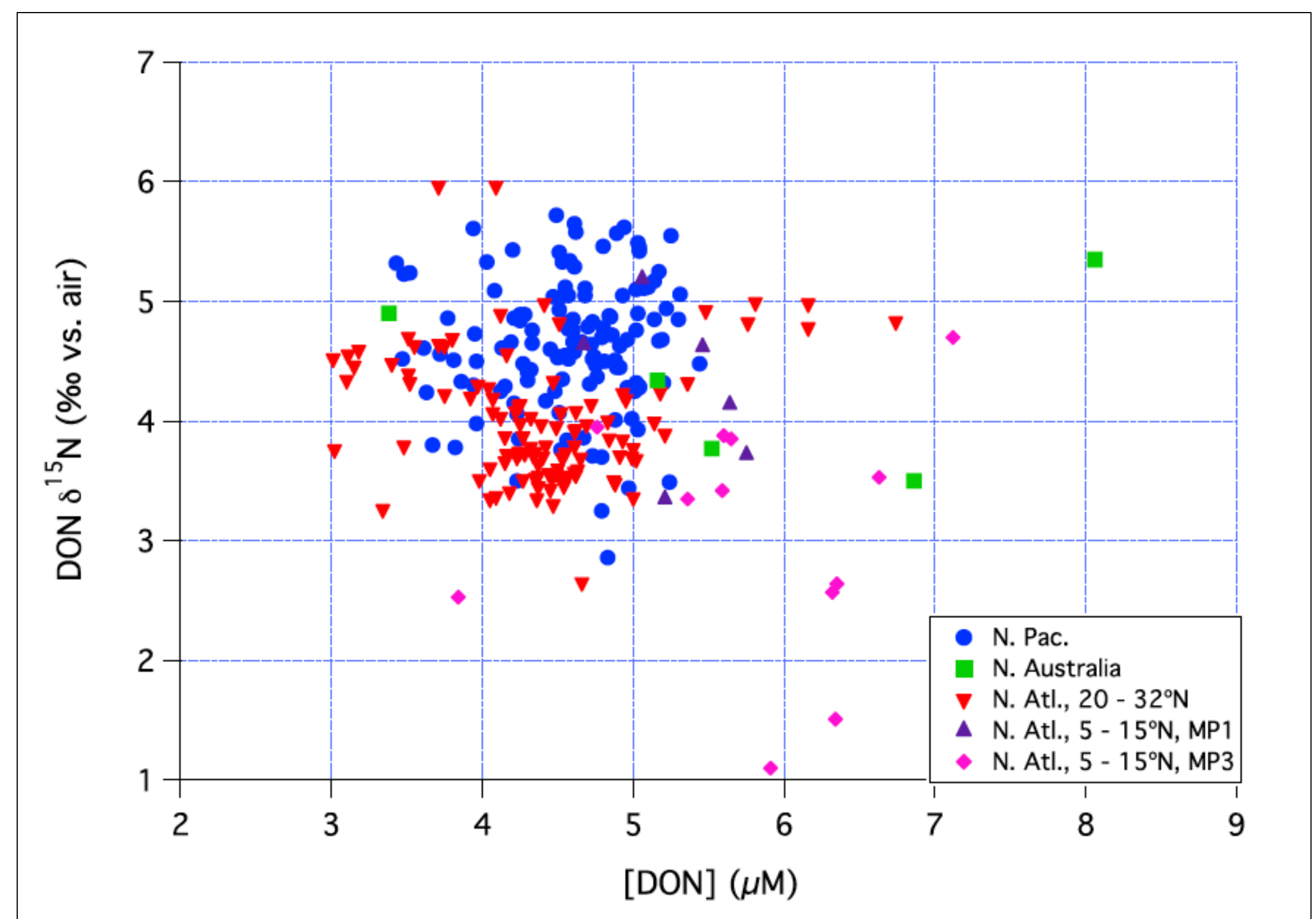


Figure 2. Bulk DON  $\delta^{15}N$  versus DON concentration for all samples collected in the upper 300 m on all cruises. Symbols follow from Figure 1. From Knapp et al. (2011).

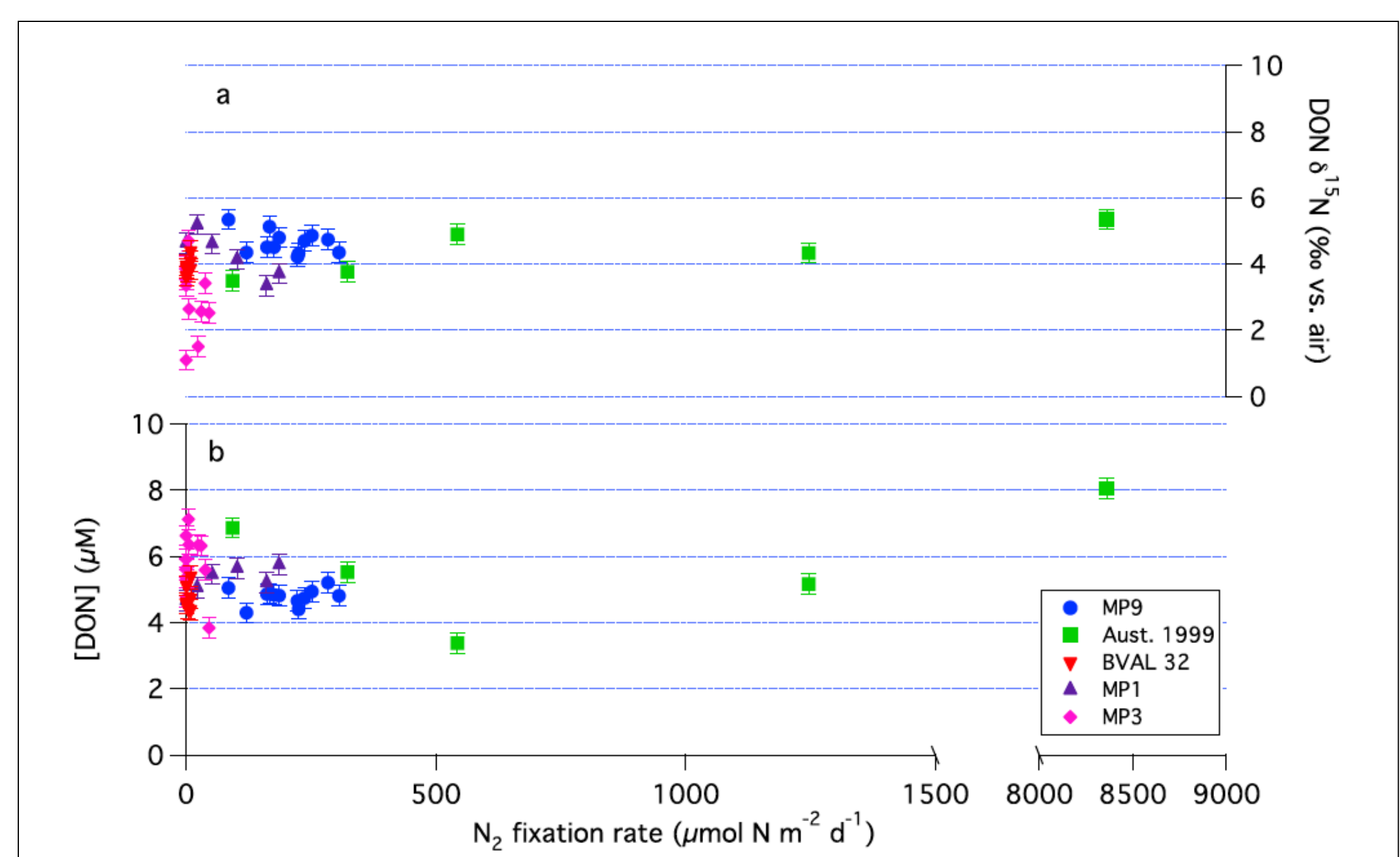


Figure 3. (a) Average upper 100 m DON  $\delta^{15}N$  for each station versus  $N_2$  fixation rate and (b) average upper 100 m DON concentration for each station versus  $N_2$  fixation rate; colors and symbols follow from Figure 1. Note the break in the x axis scale between 1500 and 8000  $\mu mol N m^{-2} d^{-1}$ . Propagated errors for DON concentration and  $\delta^{15}N$  are shown as error bars.  $N_2$  fixation rates from the Australia 1999 cruise (D. Capone et al, manuscript in preparation), MP1 and MP3 (Capone et al., 2005), and Bermuda to Puerto Rico (K.M. Achilles, unpublished thesis, 2004) cruises are *Trichodesmium* spp. specific, depth-integrated rates.  $N_2$  fixation rates from the MP9 cruise are bulk, depth-integrated rates and include contributions from all diazotrophs (Sohm et al., 2011). From Knapp et al. (2011).