Phosphonate metabolism by *Trichodesmium* IMS101 and the production of greenhouse gases

Beversdorf, L. J., A. E. White, K. M. Björkman, R. M. Letelier, and D. M. Karl

Limnol. Oceanogr., 55(4), 2010, 1768-1778 | DOI: 10.4319/lo.2010.55.4.1768

ABSTRACT: A series of laboratory experiments were conducted to investigate (1) the capacity of *Trichodesmium* IMS101 to hydrolyze phosphonates as a source of phosphorus (P) for growth, (2) the stoichiometric relationship between phosphonate use and biogenic gas production, and (3) the potential inhibition of phosphonate hydrolysis by additions of dissolved inorganic phosphorus (DIP). *Trichodesmium* IMS101 is capable of cleaving the carbon-P bond found in methylphosphonate (MPn) and ethylphosphonate (EPn), and the decomposition of these particular phosphonates results in the stoichiometric production of the greenhouse gases methane (CH_4) and ethane (C_2H_6), respectively. Growth on 2-aminoethylphosphonate (2-AEP) led to modest ethylene (C_2H_4) production. Normalized to rates of *Trichodesmium* carbon (C) fixation, biogenic gas production as a result of either MPn or EPn hydrolysis (0.95 $\pm$ 0.04 mmol CH_4 (mol C)$^{-1}$ and 1.18 $\pm$ 0.11 mmol C_2H_6 (mol C)$^{-1}$, respectively) approximates rates of DIP use (1.11 $\pm$ 0.05 P mmol P (mol C)$^{-1}$) measured in parallel cultures. DIP, MPn, and EPn can be used by *Trichodesmium* IMS101 as a sole source of P with equal metabolic efficiency. Additionally, neither MPn hydrolysis nor the production of CH_4 was significantly inhibited by additions of up to 30 mmol DIP L^{-1}. These results imply that *Trichodesmium* can use multiple P resources simultaneously for growth and that the production of greenhouse gases occurs during decomposition pathways of select phosphonates.