Quantifying the cryptic marine sulfur cycle

DAVID T. JOHNSTON[1], BENJAMIN C GILL[2], ANDREW MASTERSON[1], ERIN BEIRNE[1], KAREN L CASCIOTTI[3] AND WILLIAM M BERELSON[4]

[1]Harvard University
[2]Virginia Tech University
[3]Stanford University
[4]University of Southern California

Understanding the role that oxygen minimum zones (OMZs) play in controlling the fixed nitrogen inventory of the global ocean relies on a quantitative understanding of fixed N sources and sinks in low oxygen waters. Apparent imbalances in geochemical nitrogen budgets (*1*) have spurred numerous studies to measure the contributions of heterotrophic and autotrophic N_2-producing metabolisms (denitrification and anammox, respectively)(*2, 3*). Most recently, 'cryptic' sulphur cycling was proposed as an important means of water column organic carbon oxidation in OMZs (> 30% of carbon remineralization) and a source of the reduced nitrogen needed to drive anammox (*4*). The degree to which the cryptic sulphur cycle can fuel fixed nitrogen loss in the modern ocean requires quantifying sulphur cycling in OMZ settings. Here we provide a new constraint for OMZ sulphate reduction based on oxygen ($^{18}O/^{16}O$) and sulphur ($^{33}S/^{32}S$, $^{34}S/^{32}S$) isotopic profiles of seawater sulphate through oxygenated open-ocean and OMZ-bearing water columns. When coupled with observations and models of sulphate isotope dynamics and OMZ water mass residence time, we predict that sulphur cycling plays only a very modest role (< 1%) in OMZ carbon remineralization and fixed nitrogen loss from the oceans.

1. L. A. Codispoti (1995) *Nature* **376**, 724-724. 2. P. Lam, *et a*l (2009) *PNAS*, 4752-4757. 3. B. B. Ward *et al* (2009) *Nature* **461**, 78-80. 4. D. E. Canfield *et al* (2010) *Science* **330**, 1375-1378