DNRA vs. Denitrification-Energetic edge dictates N-cycle short-circuit

MICHIELS C C[1], HANCISSE O[1] ANDCROWE S A[1]

Microbiol.& Imm., and Earth, Ocean, and Atmos. Sci. Dpts, U. of British Columbia, Canada.
* correspondence: ccmichiels@gmail.com

The free energy yield of microbial metabolisms is a first order determinant of niche partitioning. This is particularly relevant for the N-cycle where two competing pathways in nitrate metabolims have very different biogeochmical outcomes. Denitrification, yeilds N_2, and leads to a loss of fixed nitrogen from the environment back to the atmosphere. On the other hand, dissimilatory nitrate reduction to ammonium (DNRA) short-circuits the N-cycle converting nitrate back to ammonium—this leads to fixed nitrogen retention.

We compared the energetics of nitrate reduction via DNRA and denitrification driven by a suite of organic and inorganic electron donors (ED). We varied the N-content of organic matter from Redfield ratios (C:N=16) and found that independent of the nitrogen content of the organic ED, DNRA is energetically more favourable, per nitrogen reduced, than denitrification [1]. In stark contrast, denitrification with inorganic ED is more energetic, per N reduced, than DNRA. DNRA may thus be expected to dominate in environments where organic electron donors are in abundant supply, whereas denitrification might be expected where inorganic electron donors abound. This is in line with recent results documenting the importance of sulfide dependent denitrifiers in low oxygen marine waters [2].

[1] LaRowe and Van Cappellen (2011), *Geochimica Et Cosmochimica Acta* **75**, 2030-2042 [2] Canfield *et al* (2010), *Science* **330**, 1375-1378