Photo: Laura Bristow

No laughing matter: nitrous oxide cycling in oxygen depleted waters

Laura Bristow, Associate Professor of marine Chemistry at Göteborg University

Time & place: March 6, 2024 at 15h00. William-Olsson lecture hall, Geohuset

The ocean is a major source of atmospheric nitrous oxide (N_2O), a powerful greenhouse gas and ozone destroyer, and oxygen (O_2)-depleted marine waters are hotspots of N_2O accumulation and emission. N_2O is both a product of and a substrate for microbial metabolism, but we lack a clear understanding of which microbes and bio(geo)chemical mechanisms are involved, and how these are controlled by environmental factors. Filling this knowledge gap is essential, as O_2-depleted regions are expanding and increasing fluxes of reactive nitrogen (N) from land to sea stimulate marine N cycling, which may further enhance N_2O accumulation.

Looking across low oxygen waters in coastal to open ocean settings (including Mariager Fjord, Denmark; Saanich Inlet, British Columbia, and the eastern tropical North Pacific – ETNP) we disentangled the contributions of denitrification and nitrification to N_2O production using both ^{15}N-labeled substrates and $^{18}O2$. Denitrification was shown to the dominant source of N_2O, however, the data suggested that microbes reduced the ^{15}N-nitrate in an atypical "closed" pathway without freely exchangeable intermediates. Surprisingly, no variability in the N_2O production rate via this pathway was observed over a manipulated oxygen range of 0.1 to 15 µM.

N_2O consumption was not detectable in oxycline waters but increased steeply below the oxic-anoxic interface along with the accumulation of H_2S at coastal sites. Consistent with this distribution, the process was highly sensitive to O_2, with 50% inhibition at ~150 nM O_2 added, and was stimulated by low amounts of H_2S (≤ 5 µM) while higher H_2S concentrations were inhibitory. Environmental controls need to be assessed across spatial and temporal scales if we are to build a foundation for the prediction of N_2O emissions in a changing world.

06 MAR | IGV Seminar Series & Bolin RT2 Seminar

Department of Geological Sciences
Contact information: wei-li.hong@geo.su.se, paola.manzotti@geo.su.se & christian.stranne@geo.su.se

Stockholm University