University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Science

of

JENNIFER REEVE

BSc (Haverford College, 2014)

"Pairing $\Delta N_2/Ar$ and N* tracers to observe denitrification in the Canada Basin"

School of Earth and Ocean Sciences

Monday, December 19, 2016
10:00 A.M.
Bob Wright Centre
Room A319

Supervisory Committee:
Dr. Roberta Hamme, School of Earth and Ocean Sciences, University of Victoria (Supervisor)
Dr. Jay Cullen, School of Earth and Ocean Sciences, UVic (Member)
Dr. Thomas Pedersen, School of Earth and Ocean Sciences, UVic (Member)
Dr. William Williams, Institute of Ocean Sciences, Victoria (Additional Member)

External Examiner:
Dr. Mark Altabet, Estuarine and Ocean Sciences, University of Massachusetts Dartmouth

Chair of Oral Examination:
Dr. David Berg, Department of Chemistry, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Our understanding of the global marine fixed nitrogen budget has undergone rapid growth, and as a result there is debate as to whether or not it is balanced. The Arctic plays a disproportionately large role in the sink terms of this budget. This paper works to understand the role of the Canada Basin in the nitrogen cycle. We utilize two tracers of denitrification: N_2/Ar, a dissolved gas tracer, and N*, a nutrient ratio tracer. We aim to quantify the current state of nitrogen cycling in the Canada Basin, and determine its role in the global cycle. Our paired tracer method provides support for shelf denitrification rates while providing an estimate of ventilation in the same water mass, and provides an estimate for deep benthic denitrification rates. We observe a disconnect between N_2/Ar and N* in the Pacific Upper Halocline Layer (PUHL), wherein the excess N_2/Ar we expect from N* is nearly 250% larger than the excess we observe. Our calculations suggest that an approximate steady state between benthic denitrification and gas exchange on the Chukchi shelf maintains this disconnect. Our measurements of the PUHL support the shelf denitrification rates reported from direct measurements, and can predict wind speeds required for ventilation within a factor of two. A 1D diffusion model of the old deep waters of the Canada Basin supports benthic denitrification rates of 0.095-0.15 Tg N y-1. Benthic denitrification rates determined from the model are on the low end of rates in other deep basins. Our results suggest additional measurements of these tracers in the Canada Basin and surrounding areas would help to constrain both the physical and biological processes controlling nitrogen cycling.