^{17}O-rich nitrate as a tracer for constraining nitrogen transformations in coastal sediments

*Chawalit Charoenpong[1,2], Scott D Wankel[2], Carolyn Buchwald[3,2], Wiebke Ziebis[4]

1. Chulalongkorn University, 2. Woods Hole Oceanographic Institution, 3. Dalhousie University, 4. University of Southern California

Coastal sediments are often replete in organic matter and exhibit sharp gradient in redox conditions. In addition, the oxic-anoxic interfaces are often around a few centimeters if not less below the sediment surface. This make this environment poised to harbor both oxidative and reductive nitrogen transformations. As such, the use of a single or a couple of isotope-labeling tracers to determine the rates of these many processes might suffer from the systems being underconstrained. In this work, we demonstrate how naturally-occurring, ^{17}O-rich nitrate can aid in the studying these complex systems through the ability to follow the transformations of added nitrate (NO_3^-) into other different pools of N-species and closely investigate the triple isotopic compositions (δ^{15}N, δ^{18}O, and Δ^{17}O). While we followed five different pools of N-species namely NO_3^-, NO_2^-, N_2O, NH_4^+, and total reduced N (NH_4^+ plus DON), we chose to focus this work on the intermediate nitrite, NO_2^-. For all intact flow-through core incubations done on the sediments collected from Sylt Island, Germany, sediments acted as sources for NO_2^- in all experimental manipulations including sediment type, dissolved oxygen level, and NO_3^- loading. Unlike in the environments that are solely driven by reductive processes where the changes in δ^{15}N and δ^{18}O are coupled, the co-occurrence of both oxic and anoxic in the sediments such as ones from this study cause the δ^{15}N and δ^{18}O to decouple primarily because O is often subject to more processes than N. By using three isotope systems along with the change in concentrations, we demonstrate how we can use a natural abundance appraoch and rely on a series of mathematical equations to solve for different N transformation rates.

Keywords: nitrogen, isotope, 17O, sediments