Larry Dishaw

The gut microbiota of animals is an emerging and complex system of study in scientific research; in human biomedicine, it has taken center stage. The gut microbiome can shape immune development, human physiology, and a variety of gastrointestinal conditions. The gastrointestinal tract maintains a dynamic community of trillions of microbial cells that can interact with or be infected by bacteriophages. In this work, we are leveraging an invertebrate chordate, *Ciona robusta*, to study how phages impact host- associated microbial communities. *Ciona*are siphon/filter-feeding organisms that concentrate microbe-rich seawater yet have been shown previously to maintain a stable microbiome (e.g., bacterial and viral communities). Using germ-free approaches, this model system can help us dissect bacterial and phage dynamics that are more challenging in other systems. Future directions will include a continuation of lytic phage screenings and implementation of germ-free rearing methods. Results are expected to yield higher concentration and localized centralization of bacteria in *Ciona* that are exposed to lytic phage, in other words, that phages will impact the colonization dynamics within the gut.

Brad Rosenheim

Modeling the last deglaciation in Antarctica requires accurate radiocarbon dates. Sediments collected from Antarctica and the Southern Ocean are carbonate-poor. Typically, bulk acid-insoluble organic matter (AIOM) is used for standard radiocarbon dating; however, these dates are often inaccurate due to glacial transportation of older organic carbon material. Alternative methods of radiocarbon dating are necessary to provide accurate dates and give insight into the last glacial retreat to assess current warming trends. Here, we focus on understanding the kinetics of ramped pyrolysis to improve dating techniques. We analyzed grain size distribution to observe the effects on activation energy. The two samples studied were diatom ooze and silt sediments. These layers, known together as a “couplet”, indicate regional deglaciation.

Diatom oozes are created when exposed to sunlight and the silica shells of the diatoms are deposited onto the seafloor. When the seasonal ice forms, the silt layer is created as the environment is not habitable for diatom growth and deposition. Typically, this is representative of deglaciation because the ice sheet retreats and the diatom layer forms, followed by seasonal ice formation and creation of the silt layer.

The data suggests there is no direct correlation between grain size and activation energy; however, the presence of diatoms drastically increases the activation energy due to the silicon composition. The findings are important because we have gained insight into the relation of grain size and activation energy. This will improve radiocarbon dating of carbonate-poor sediments typical of the Antarctic region.

Amelia Shevenelle

The Aurora Subglacial Basin, which terminates along the Sabrina Coast, East Antarctica, contains enough ice to raise global sea level by 3.5 meters (11.5 feet). Modern observations indicate that the Totten Glacier, a marine-based system on the Sabrina Coast, is rapidly losing mass. This is primarily due to an influx of warm modified Circumpolar Deep Water (mCDW) that erodes the grounding line. To understand the dynamics of warm water impacting the Sabrina Coast, we investigate regional depositional environment, sediment conveyance, and climatic variability since the last deglaciation (16-0 ka). We employ grain size analyses of sediment samples collected from gravity and piston cores recovered from the Sabrina Coast continental shelf in 2014 to assess the physical processes of sedimentary transport and deposition at the site.

Previous Antarctic margin investigations demonstrate a difference in the grain size of the terrigenous sediment fraction between grounding line-proximal and open-marine depositional settings, with ice-proximal settings being characterized by a higher abundance of larger grains. Sediment can be transported by glacial meltwater plumes and icebergs, or delivered via ocean currents, such as the Antarctic Coastal Current. Our preliminary results are derived from laser diffraction analysis of samples between 0 -2000 µm on a Malvern Mastersizer Hydro 2000 Laser Diffraction Particle Size Analyzer. We find that after deglaciation, grains are less well sorted, suggesting delivery in an ice-proximal glacimarine environment. The early and middle Holocene exhibit a higher relative contribution of silt sized grains, suggesting transport by ocean currents. The late Holocene exhibits a less well-sorted distribution indicative of the re-advance of ice in the Neoglacial period. Support for our interpretations of grain size is based on additional proxy data of primary productivity (diatom and foraminifera abundance), and upper ocean temperature (TEX86). We hypothesize that our grain size results exhibit trends related to changing glacial and sea ice extent, and zonal wind strength.

Dr. Xinfeng Liang,

Due to sparsity of available measurements, quantifying and understanding global and regional heat content changes in the deep and abyssal ocean is a major scientific challenge. Purkey and Johnson (2010) analyzed historical repeated hydrographic section data from 1980s to 2010 and found statistically significant warming trend across most deep ocean basins, particularly in the Southern Ocean. Desbruyères et al. (2016) examined global deep ocean heat content changes with additional five years observational data. However,near one-third of the repeated sections only have two measurements over a few decades and only few repeated sections exist in each major ocean basin. The sparsity of data in both space and time will result in uncertainties in the estimates of multidecadal temperature trends. The mismatches of observational locations and neglect of seasonality will also bias the calculate trends. In this study, we use hydrographic measurements and a state-of-the-art ocean state estimates (ECCO v4r3) to access uncertainties of the trends calculated from the hydrographic measurements. First, we subsample Temperature, Salinity and Depth for all observational points in space and time, and calculate the warming trend like Purkey and Johnson (2010).

Timothy Conway

Nickel is an important micronutrient in oceanic environments; with low surface concentrations that increase with depth, as well as a component in phytoplankton's oxidative defenses.[1,2] To comprehensively investigate Ni isotope distributions, a method for separating the trace metal from major cation concentrations present in seawater is needed. The goal of this project is to refine the purification method to separate the trace amounts of Ni from the seawater's high Na and MG concentrations, so precise isotopic ratios can be measured. To test separating Ni from Na, the existing lab purification method for separating Fe, Zn and Cd from seawater[3] was tried for Ni. Then a similar method[4] was tried, changing the conditioning reagent from 10 M HCl + 0.001 % H_2O_2 to 11M Acetic Acid + 4M HCl + 0.01% H_2O_2. The results showed both methods were able to separate Fe and Zn, with the second method separately eluting Cu; however, Ni was eluted with a significant amount of major cations in both methods and the second method had an extensive elution time. A third method was tried, which added an extra purification step to the lab method. This new step fully separated the Ni from Mg and Na. In conclusion, a new step was added to the lab method, which successfully separated Iron, Zinc, Cadmium, *and* Nickel from seawater. Future work seeks to apply this combined method to measure Ni concentrations and Ni isotopic ratios from the GEOTRACES GA02 section between Greenland and Antarctica to investigate Ni cycling.