Collaborative Research: Denitrification and global change in Bering Sea shelf sediments

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Observed patterns of seasonal and inter-annual variation of ice cover in the Bering Sea appear to be linked to global climate change. These patterns suggest that long-term warming of the Bering Sea would cause a shift in timing of the spring bloom and, concomitantly, in energy flow from benthic to pelagic communities. The PIs will test the hypothesis that variation in the timing of the spring bloom changes the rate of denitrification in Bering Sea sediments, which will have substantial consequences for productivity in this region.

Denitrification in shelf sediments of the southeastern Bering Sea is estimated to remove about one third of the total nitrate supply to the Bering Shelf. The specific hypotheses that the PIs propose to test are:

1. Dentirification covaries with organic matter input to the sediment and infaunal burrow densities, peaking at intermediate infaunal densities,
2. Macrofaunal burrow ventilation rates covary with organic matter input,
3. Return of nitrogen to the overlying water will be a non-linear increasing function of organic-matter input, and
4. The fraction of export production reaching the sediment will change with the timing of sea ice melt.

To test these hypotheses, they will participate in oceanographic cruises in 2007-2009, conduct onboard experiments, and collect core samples for the measurement of profiles and fluxes of oxygen, nitrate, ammonium, phosphate and silicate. They will also collect samples for measurement of 222Rn and 210Pb profiles, from which they will calculate sediment bioirrigation rates and bulk sedimentation rates, respectively. This combination of measurements will allow them to estimate sedimentary denitrification rates, overall benthic carbon oxidation rates, macrobenthic irrigation rates and organic-matter burial rates, and to test their hypotheses. Additionally, they will use the data to construct a mathematical model of sedimentary nitrogen cycling that can be used as a boundary condition for larger Bering Sea Ecosystem models.

It is assumed that, at present, the nitrogen needed to fuel the primary production on the Bering Sea shelf is derived from cross-shelf transport of oceanic waters and denitrification in shelf sediments. How the relative importance of these two sources of nitrogen would change under an altered ice regime and the consequences for the ecosystem remain important unanswered questions. This research effort should provide a considerable improvement in our knowledge of existing conditions and our projections of future conditions.