Particulate carbon flux, flux attenuation, and export efficiency in the summer of 2019 across the northern Gulf of Alaska shelf

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— Introduction —

- The Northern Gulf of Alaska shelf was designated as a new Long Term Ecological Research project in 2018 (**NGA-LTER**).
- After 30 years of monitoring, the biological carbon pump remains poorly characterized.
- Ecological models rely on accurate rate measurements in order to parameterize carbon flow.
- **We sought to parameterize the strength and efficiency of the biological carbon pump and determine drivers of carbon export during the summer (July) in the NGA.**

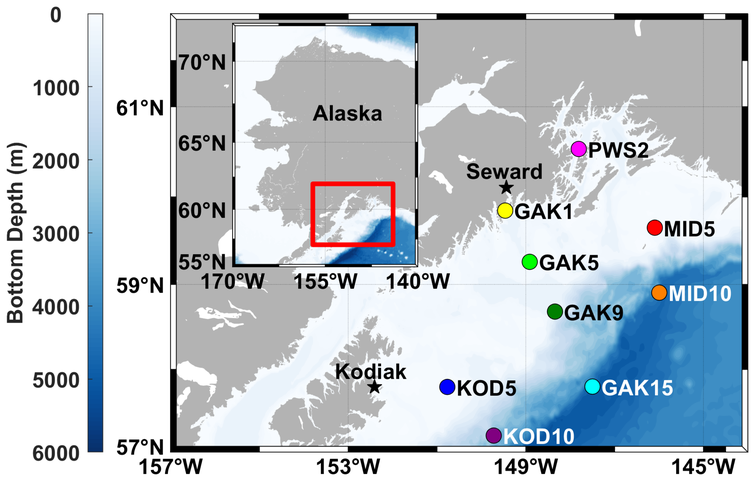

Figure 1: The Northern Gulf of Alaska shelf is our study area with nine stations sampled.

—Methods —

- A short-term drifting sediment trap was deployed at nine stations for between 6 and 19 hours collecting sinking particles at 2 to 5 discrete depths (Figure 1).
- Bulk particles collected were used to calculate particulate organic carbon (POC) flux (Figure 2).
- Viscous gels collected intact sinking particles to determine particle type (Figure 4).
- Twenty-four-hour Carbon-13 based primary productivity measurements were performed simultaneously with sediment trap deployment (Figure 3).
- At three stations, dilution experiments were performed to estimate grazing on production (Figure 4).

— Results and Discussion —

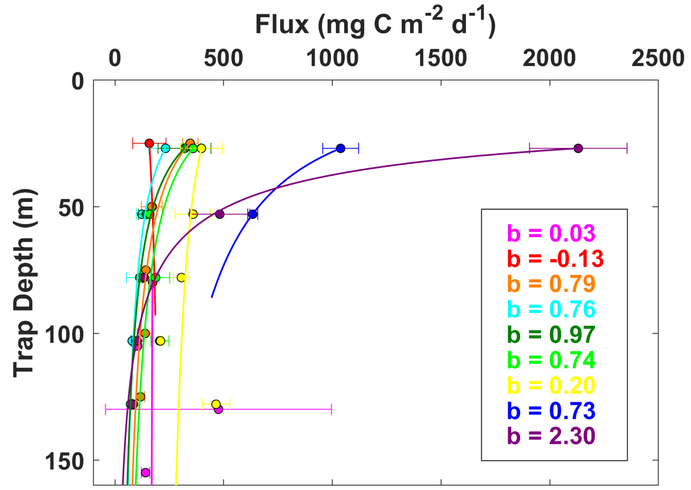

Figure 2: POC flux attenuation curves fitted to discrete POC flux measurements using the power law Martin curve (b = coefficient of attenuation) (Martin et al., 1987).

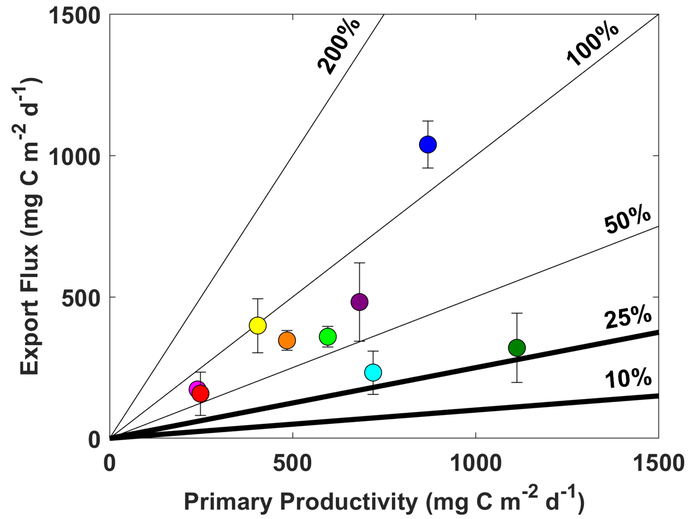

Figure 3: Flux is plotted against primary productivity and export ratio contours are displayed. A typical shelf has an export ratio around 25% and the open ocean 10% (in bold).

- POC flux decreases with distance from shore on GAK line.
- Highest fluxes occurred on the Kodiak Line.
- Fastest POC flux attenuation occurred at KOD10 and GAK9.
- Slowest POC flux attenuation occurred at the most inshore stations (PWS2 and GAK1) perhaps due to advected material.

- Export ratios range from 29 - 119%, averaging 68 +/- 30%, indicating efficient transfer of freshly produced material.
- Stations with high export ratio and relatively low primary productivity (GAK1 in yellow) can potentially indicate advected material entering the water column, non-steady state conditions, or a collection bias.

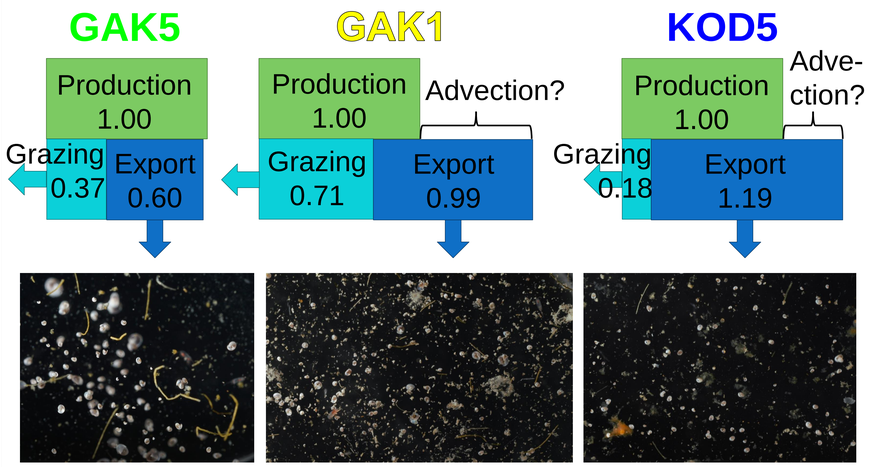

Figure 4: A carbon budget model of growth and grazing pressure, estimated from dilution experiments, and percent POC export flux (Figure 3) at three overlapping stations. Excess carbon is attributed to lateral advection. Sinking particles include euphausiid fecal pellets, pteropods, diatoms, and aggregates.

—Conclusions—

- Relatively slow flux attenuation and high export ratios indicate deep carbon penetration.
- The flux was characterized by very long (>3 cm) delicate chains of Rhizosolenia diatom frustules, other diatom chains, zooplankton swimmers, fecal pellets, and many pteropods.
- Mismatch between grazing and export highlights the importance of advection in this region.
- **Our results indicate the important role of advection and zooplankton grazers in creating strong silica and carbon pumps over the Northern Gulf of Alaska shelf during the summer months**.

— Acknowledgments —

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