PARAGON II
Cruise Planning

Jan 20, 2022, 2PM Eastern
Agenda for today

1. Brief recap of PARAGON science objectives
2. Brief recap of preliminary findings from PARAGON I
3. Discussion of unresolved (and new) questions to guide PARAGON II activities
4. PARAGON II cruise logistics
5. Input on major PARAGON II sampling activities
SCOPE PARAGON
PARticles And Growth in the Oceanic Nutricline (PARAGON)

• Improve understanding of the processes and rates of biological particulate matter transformations (e.g., production, decomposition, sinking) as well as ecological interactions that occur in association with suspended and sinking particles

• PARAGON science objectives were defined by the activities of 3 working groups:

1. Characterization of sinking particles over the upper 500 m (White, Karl, Van Mooy, Repeta, Ingalls, Dyhrman, Zehr)
2. Characterization of microbial assemblages associated with sinking & suspended particles (Caron, Demory, DeLong)
3. Quantification of rates, stoichiometry, and controls on particle flux attenuation (Church, Repeta, VanMooy, Karl, Granzow, White, Berube)
2021 SCOPE PARticles And Growth in the Oceanic Nutricline (SCOPE-PARAGON)

What's New

Overview

- Cruise Binder
- Event Log (scanned originals)
- Event Log (cleaned up, digitized)
- Array Coordinates
- Photo Gallery

Pre-cruise Documents

- Cruise Planning
- Working Group 1 Summary (Aug 26, 2020)
- Working Group 2 Summary
- Remineralization Working Group Meeting (Aug 27, 2020)
- PARAGON PITS Primer
- Shipping Information
- Cruise Planning Meeting: Part 1, Part 2 (Feb 11, 2021)
- Sampling and Incubation Outline (Mar 16, 2021)
- Net Trap and Incubation Planning (Mar 19, 2021)
- Participant Logistics (Apr 20, 2021)

The 2021 SCOPE-PARAGON research expedition is a coordinated effort to characterize particle dynamics and remineralization in the upper 500 m of the North Pacific Subtropical Gyre. Despite the importance of particles as key sites of biological activity in an otherwise dilute seawater medium, there remain major gaps in our understanding of the specific processes and organisms controlling particle transformations. The 2021 SCOPE-PARAGON cruise will be directed towards understanding the processes and rates of biological particulate matter transformations (e.g., production, decomposition, sinking) as well as the ecological interactions that occur in association with suspended and sinking particles. These targeted studies of particle dynamics at Station ALOHA will leverage ongoing ecological and biogeochemical modeling efforts in SCOPE.
Specific research themes guiding PARAGON

• Depth-dependent changes in energy and elemental (C, N, P, H, O, Fe, etc.) content of suspended and sinking organic matter
• Particle size structure (both suspended and sinking)
• Microbial communities and major microbial metabolisms associated with sinking and suspended organic matter
• Contributions of living and dead organisms to suspended and sinking particles
• Rates, stoichiometry, and controls on organic matter mineralization
• Fluxes of nitrogen and phosphorus to the euphotic zone
• Turnover of nitrite and microorganism catalyzing nitrite source/sink pathways
PARAGON II

- R/V Kilo Moana
- Currently 15 days
  - Loading: August 10;
  - underway August 11-25;
  - offload August 26
    - these dates may change
- 26 scientists (inclusive of 2 shipboard technicians)
- Support student and post-doc research, specifically projects initiated on PARAGON I that require follow-up sampling or additional experiments
- Support from SCOPE team (Tim, Ryan, and Brandon)
Preliminary findings from PARAGON I

• Sampled leading edge of decaying anticyclonic eddy bloom.

• High suspended particle concentrations at the onset of cruise, with suspended particle size distribution initially bimodal (small, i.e., 2-4 µm and “large”, i.e., 5-50 µm) particles, transitioning to mostly ”small” particles toward the end of the cruise. Most of the particles were non-living.

• Rates of upper ocean productivity and N$_2$ fixation typical of HOT climatology for July. High concentrations of suspended particles presumably reflect legacy of prior elevated N supply (via N$_2$ fixation) and production.

• Very high PC and PN export (~1.6X and 2.4X the HOT climatology for July), in particular in the first 5 days.

• PC/PN fluxes from net traps ~10X lower than PITs.

• Fe-limited microorganism growth in the lower euphotic zone / upper mesopelagic waters.
Some unresolved (and new) questions deserving of work on PARAGON II

1. Why do the different collectors of sinking particles differ in their estimation of particle flux?

2. How do changes in particle morphology and composition (size, % organic matter, types of organisms) influence the downward flux of elements and energy?

3. How does variability in the availability and supply of nutrients (N, P, Fe) to the lower euphotic zone / upper mesopelagic waters influence microorganism metabolism, particle decomposition, and the stoichiometry of organic matter remineralization?
Q1. Why do the different collectors of sinking particles differ in their estimation of particle flux?

%PIC (relative to PC) for HOT (Jul/Aug): ~9%
%PIC (relative to PC) for PARAGON nets: 8%
%PIC (relative to PC) for PARAGON PITs**: <1%

** due to undersaturation of CaCO₃ in PITs solution
Q2: How do changes in particle morphology and composition (size, %organic matter, types of organisms) influence the downward flux of elements and energy?
Q2: How do changes in particle morphology and composition (size, % organic matter, types of organisms) influence the downward flux of elements and energy?

1. Elevated concentrations of suspended particles
2. Greater proportion of large (5-50 μm) suspended particles at beginning of cruise
3. High particle flux, particularly July 27-29
Q2: How do changes in particle morphology and composition (size, % organic matter, types of organisms) influence the downward flux of elements and energy?

- What are the relationships between particle size and sinking speed?
- To what extent do variations in particle sinking speed vs changes in particle concentrations drive variability in sinking flux at ALOHA?
Q3. How does variability in the availability and supply of nutrients (N, P, Fe) to the lower euphotic zone / upper mesopelagic waters influence microorganism metabolism, particle decomposition, and the stoichiometry of organic matter remineralization?

![Graph showing nutrient concentrations and dFe:N ratios at chlorophyll maxima.](image)

Our focus in PARAGON HOT program data and Hawco et al. 2021
Q3. How does variability in the availability and supply of nutrients (N, P, Fe) to the lower euphotic zone / upper mesopelagic waters influence microorganism metabolism, particle decomposition, and the stoichiometry of organic matter remineralization?

The availability of Fe (at 150 m) appears to influence the time scales over which microorganisms respond to changes in organic carbon.

Lauren Manck – see poster next week
Some unresolved (and new) questions deserving of work on PARAGON II

1. Why do the different collectors of sinking particles differ in their estimation of particle flux?
2. How do changes in upper ocean particle morphology and composition (size, % organic matter, types of organisms) influence the downward flux of elements and energy?
3. How does variability in the availability and supply of nutrients (N, P, Fe) to the lower euphotic zone / upper mesopelagic waters influence microorganism metabolism, particle decomposition, and the stoichiometry of organic matter remineralization?
Input on activities planned for PARAGON II

- Sediment traps (PITs, indented sphere, nets) – # arrays, depths, # traps
- Wirewalkers (2X)
- Gliders (including turbulence)
- CTD casts
- Trace metal casts
- Snowcatchers (x2)
- Radioisotopes ($^3$H, $^{55}$Fe, $^{14}$C)
- In situ arrays: N$_2$ fixation, productivity?
- Lab vans: trace metal, radiation (OTG), BEACH lab
- Incubators: temperature controlled on deck and in ship