The Role of Food Supply in Structuring Barkley Canyon Benthic Fauna

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Food quantity vs quality

- Food quantity → benthic biomass and abundances

  Food quality → species composition

- Submarine canyons are conduits of organic matter

  Increase food supply → biomass hot spots

<u>What is the role of food quality?</u>

"the degree to which ***quantity*** and ***composition*** of accessible food fulfill ***consumer nutritional needs***"

Measurements

- C:N
- Chl/Phaeo (freshness of the detritus)
- Essential compounds (lipids and carotenoids)

Barkley Canyon

1- Barkley Canyon food quality

2- Barkley Hydrates

3- Enrichment experiment

Barkley Canyon food quality

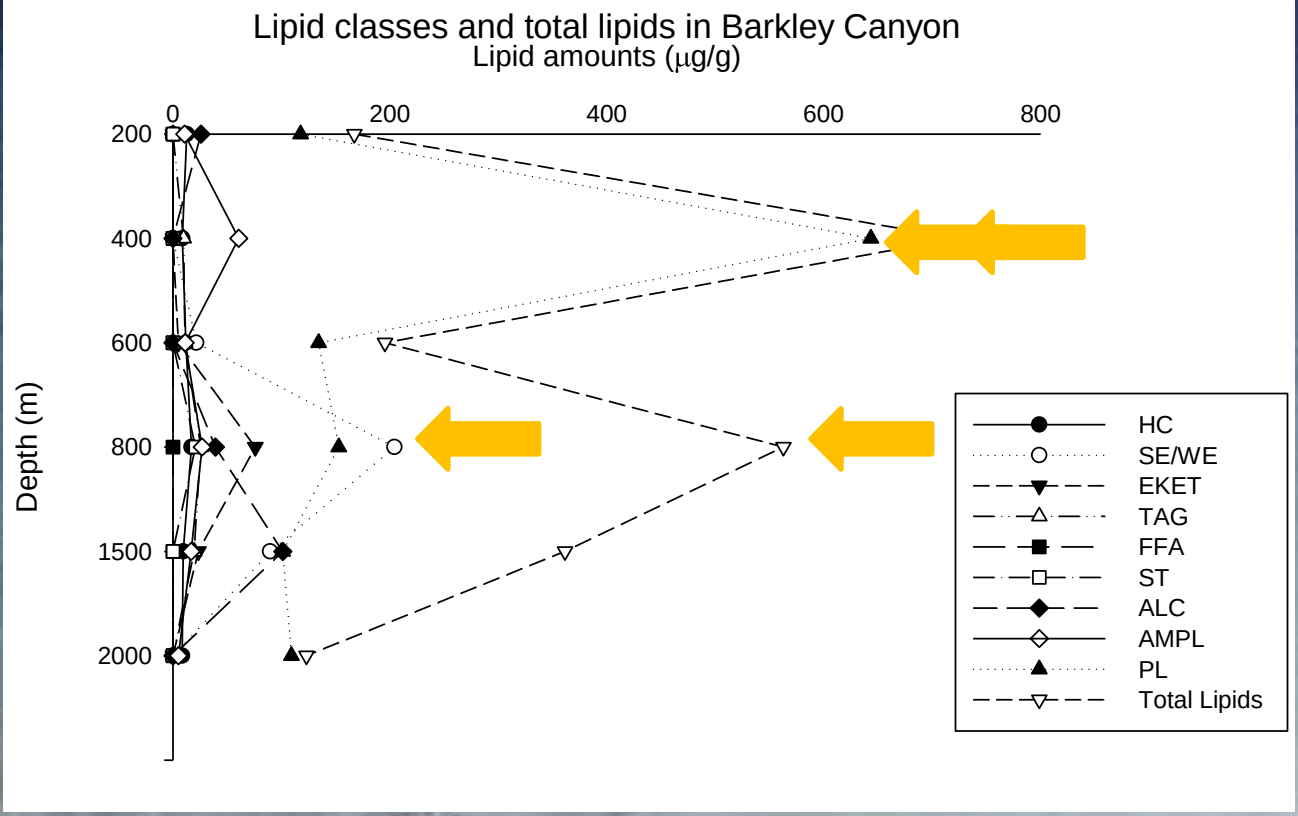
Objective 1

Determine the quantity and quality of the food supply along a submarine canyon

Sample collection and resolution

- Particulate organic matter from bottom water sampled with pumps mounted on the ROV
- Sediment organic matter sampled with push cores
- Sampling resolution
  - along Barkley Canyon axis:
    - Upper Slope (200, 300, 400, 600, 800 m)
    - Mid Slope (1500 m)
    - Lower Slope (2000 m)
  - Canyon wall: Barkley Hydrates (890 m)

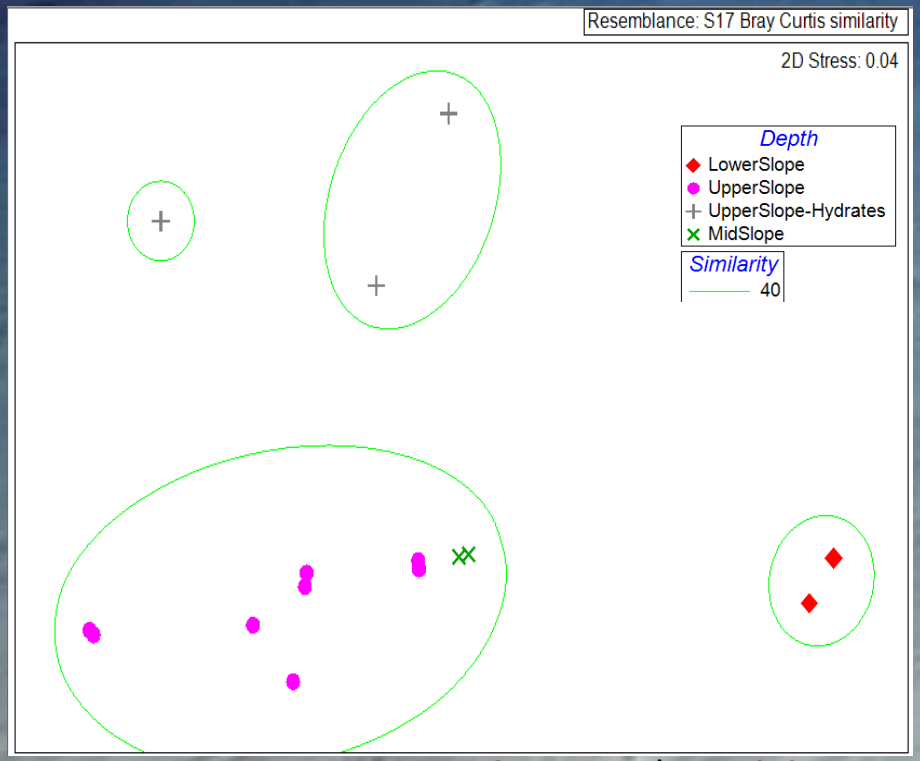
Lipid composition – bottom water



- Increase in total lipids:
  - 400 m → phospholipids (PL) → indicative of productivity → **bacteria?**
  - 800 m – (1500 m) → wax esters (SE/WE) → indicative of **zooplankton**

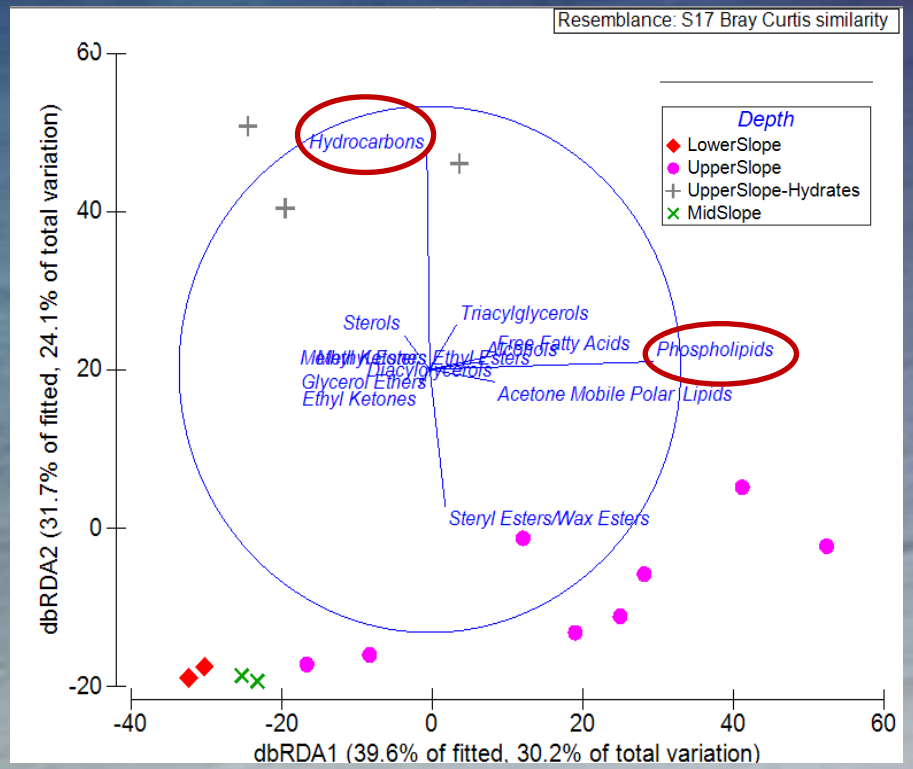
Lipid composition - Sediment

nMDS lipid composition (µg/g)



PERMANOVA: p-value < 0.05

Redundancy analysis



- Significantly lower sediment lipids at 2000 m
- Sediment lipids at Barkley Hydrates rich in hydrocarbons

Barkley Hydrates

Objective 2

Determine the nutritional dependency (temporally and spatially) of Barkley Hydrate infauna to the methane outcrop

Sampling collection

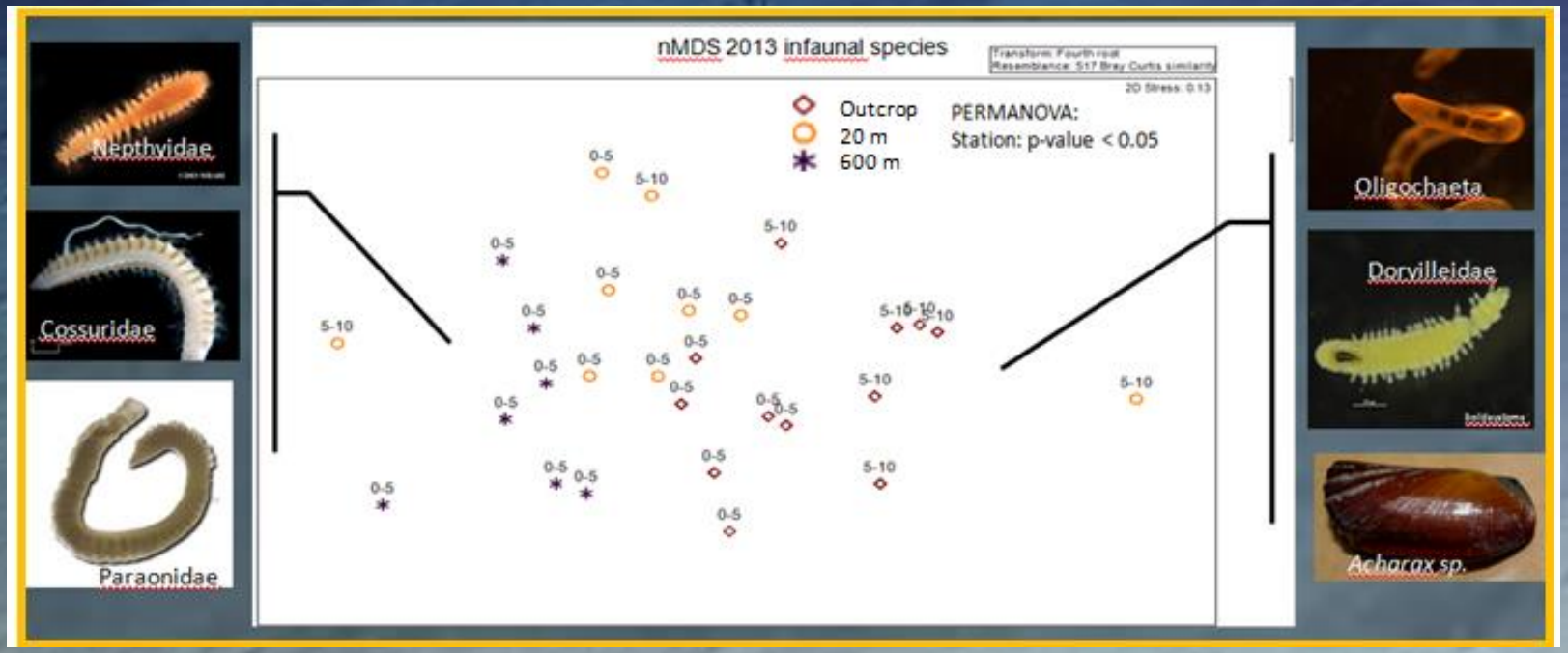
Spatial resolution

Temporal resolution: Sept 2013, May 2014

Push Cores for:

- organic matter (TOC, TN, Chl/Phaeo, lipid)
- grain size
- infauna

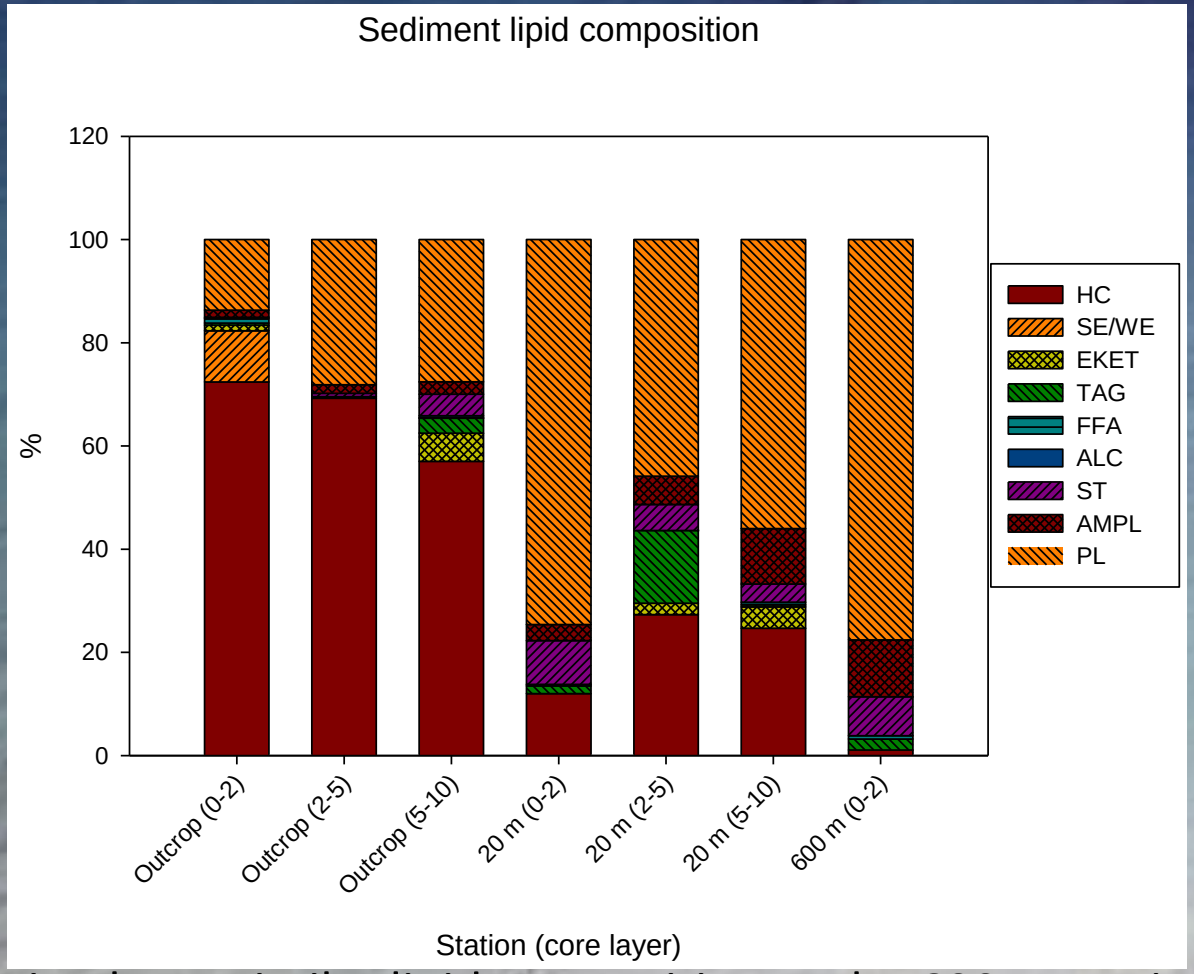
Barkley Hydrates infaunal distribution



Unique infaunal community at clam bed outcrop (oligochaetes, dorvilleids and *Acharax* sp.)

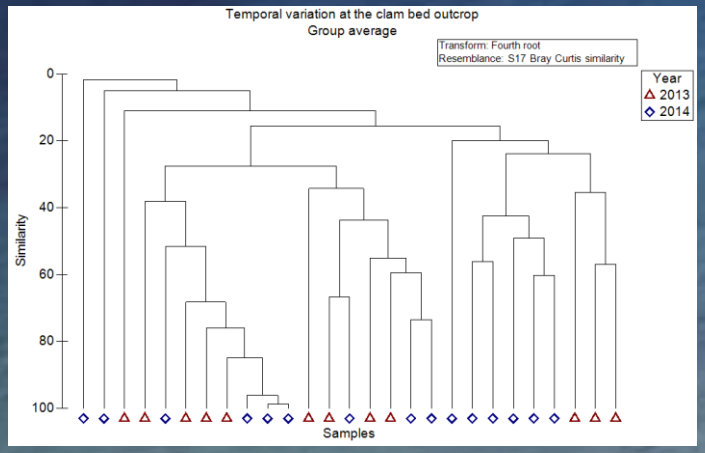
20-m station appears transitional in community structure

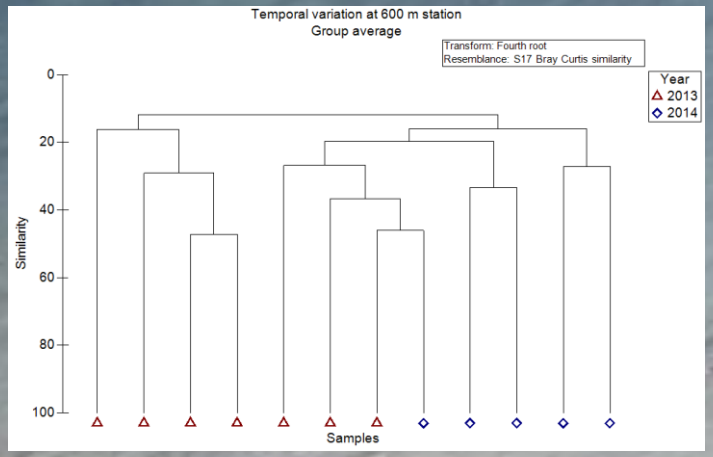
Barkley Hydrates infaunal distribution

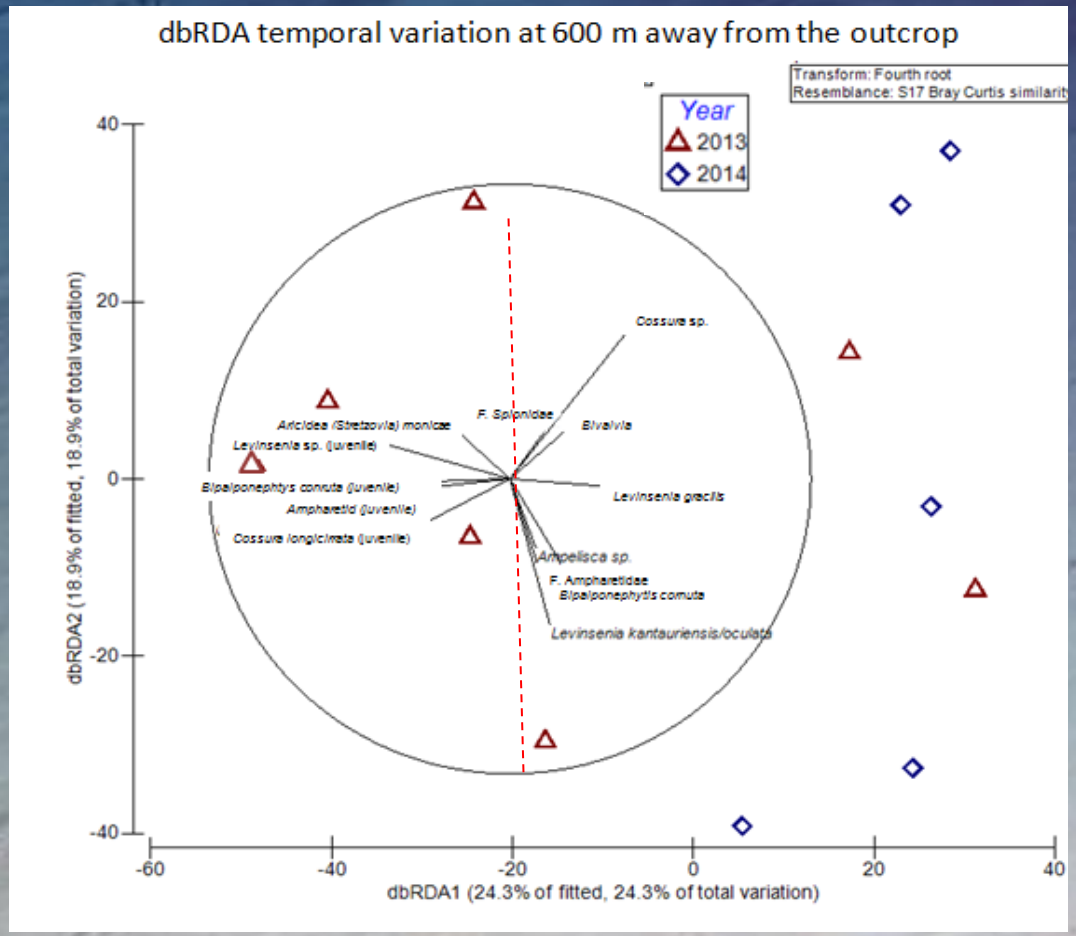


20-m station has a similar lipid composition to the 600-m station but with remains of lipid classes characteristic of the outcrop clam bed (i.e. Hydrocarbons)

Barkley Hydrates temporal patterns







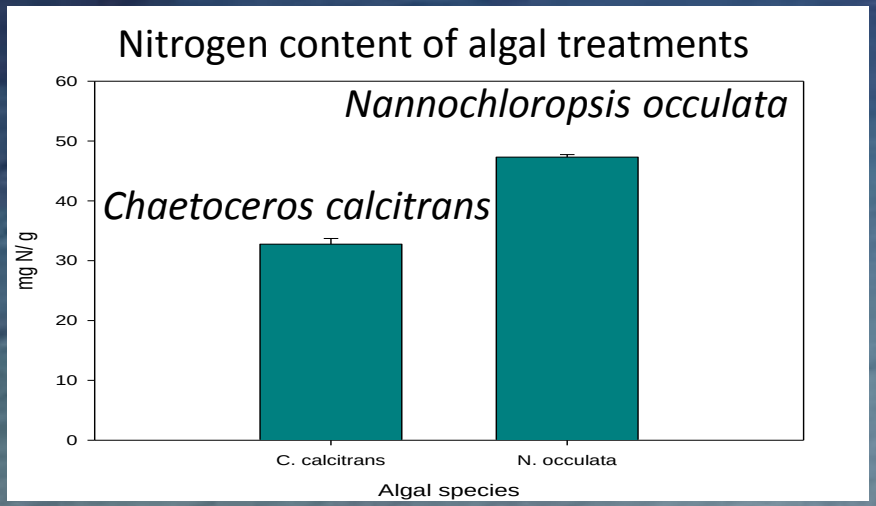
- Temporal variability only in POD3, driven by recruitment event in Sept 2013

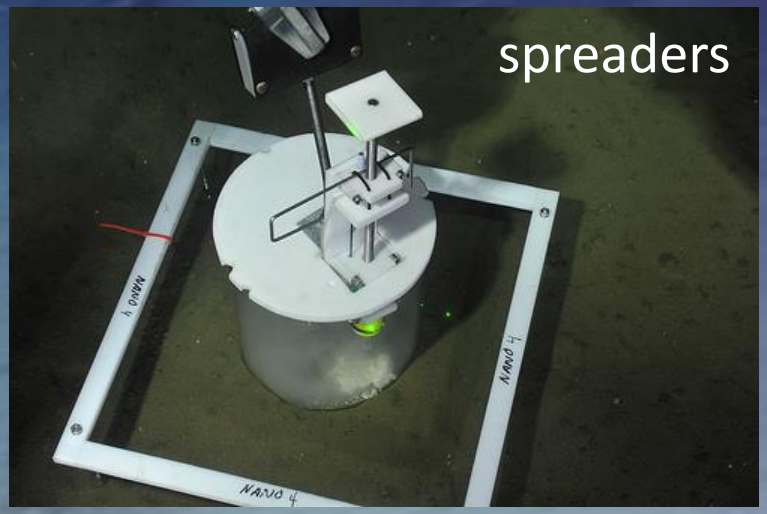
Enrichment experiment

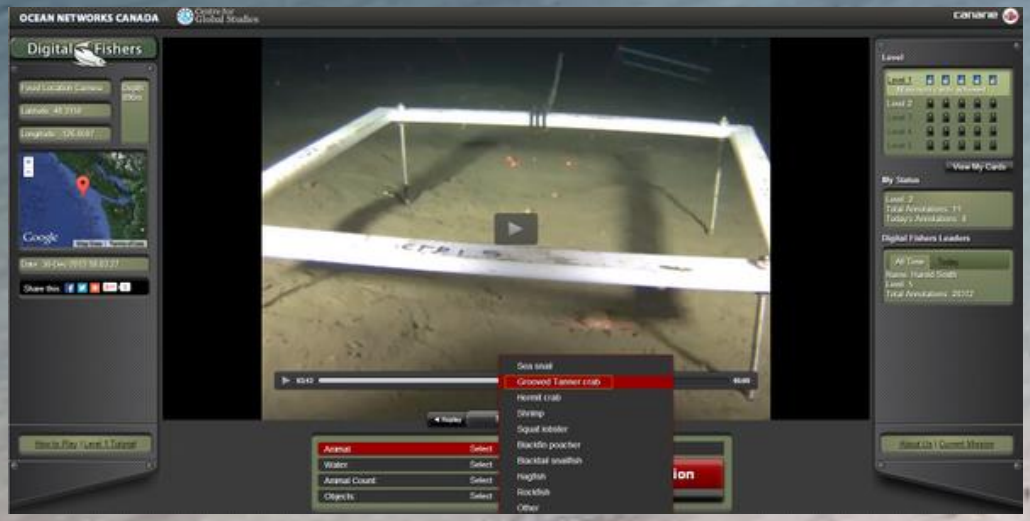
Objective 3:

Determine the influence of food pulses with differing qualities on benthic communities

Experiment set up





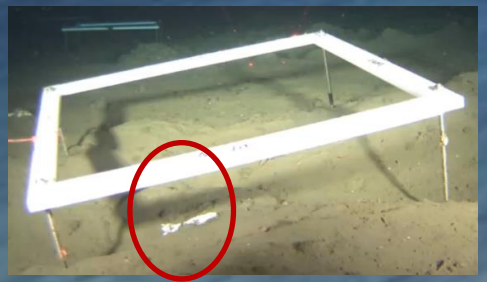
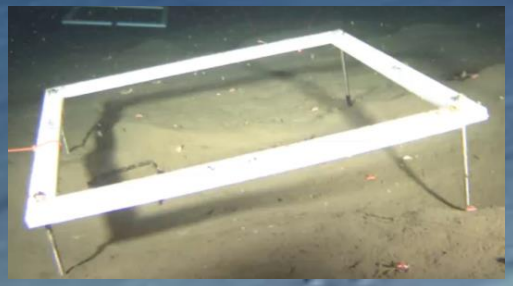
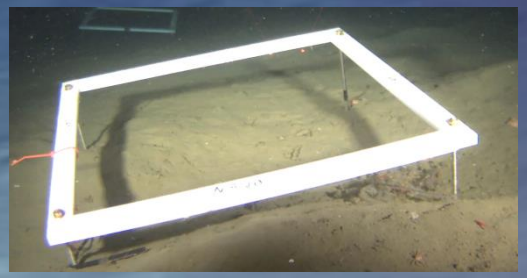


- One replicate in front of POD3 camera used for digital fishers campaign
- Recovery of experiment after 8 months
  - Push cores for infauna and organic matter (TOC and TN)

Enrichment patch disappearance

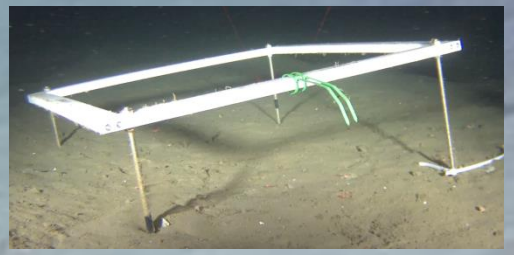
13 Sept 2013 | 09 Jan 2014 | 30 April 2014

N. occulata

C. calcitrans





- *Nannochloropsis oculata* enrichment patch disappeared faster than *Chaetoceros calcitrans*
- No differences in infaunal community structure after 8 months

Conclusions – Barkley Canyon food quality

- Food quality heterogeneity in Barkley Canyon driven by:
  - biology (zooplankton migration),
  - geology (methane hydrates)
  - topography ?
  - circulation ?

- Depth is not the only factor influencing food quality in Barkley Canyon

Conclusions – Barkley Hydrates

- Specialized Hydrate macrofaunal communities enhance canyon beta diversity
- Influence of methane energy source prevalent 20 m from clam bed outcrop
- Hydrates dampen seasonal variation in macrofaunal communities
- Barkley Hydrates macrofaunal communities depend strongly on the more permanent methane-derived food source rather than a seasonal phytodetrital input.

Conclusions – Enrichment experiment

- Quality of food pulses can shorten food processing time almost two-fold
- Given that quality influences food processing, different processing rates might be expected along submarine canyons and not just with depth

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