Life on Methane:
An introduction to cold seeps

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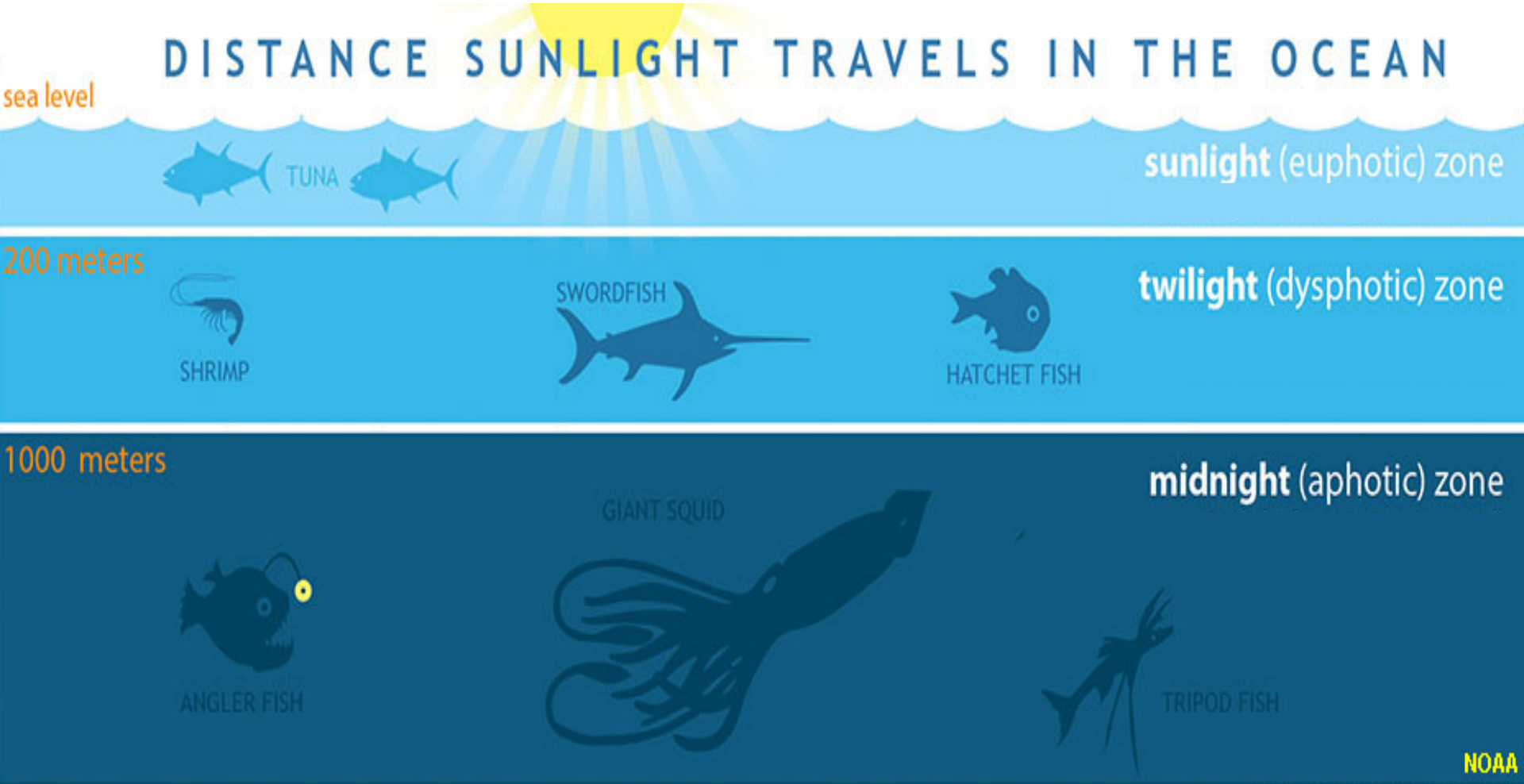
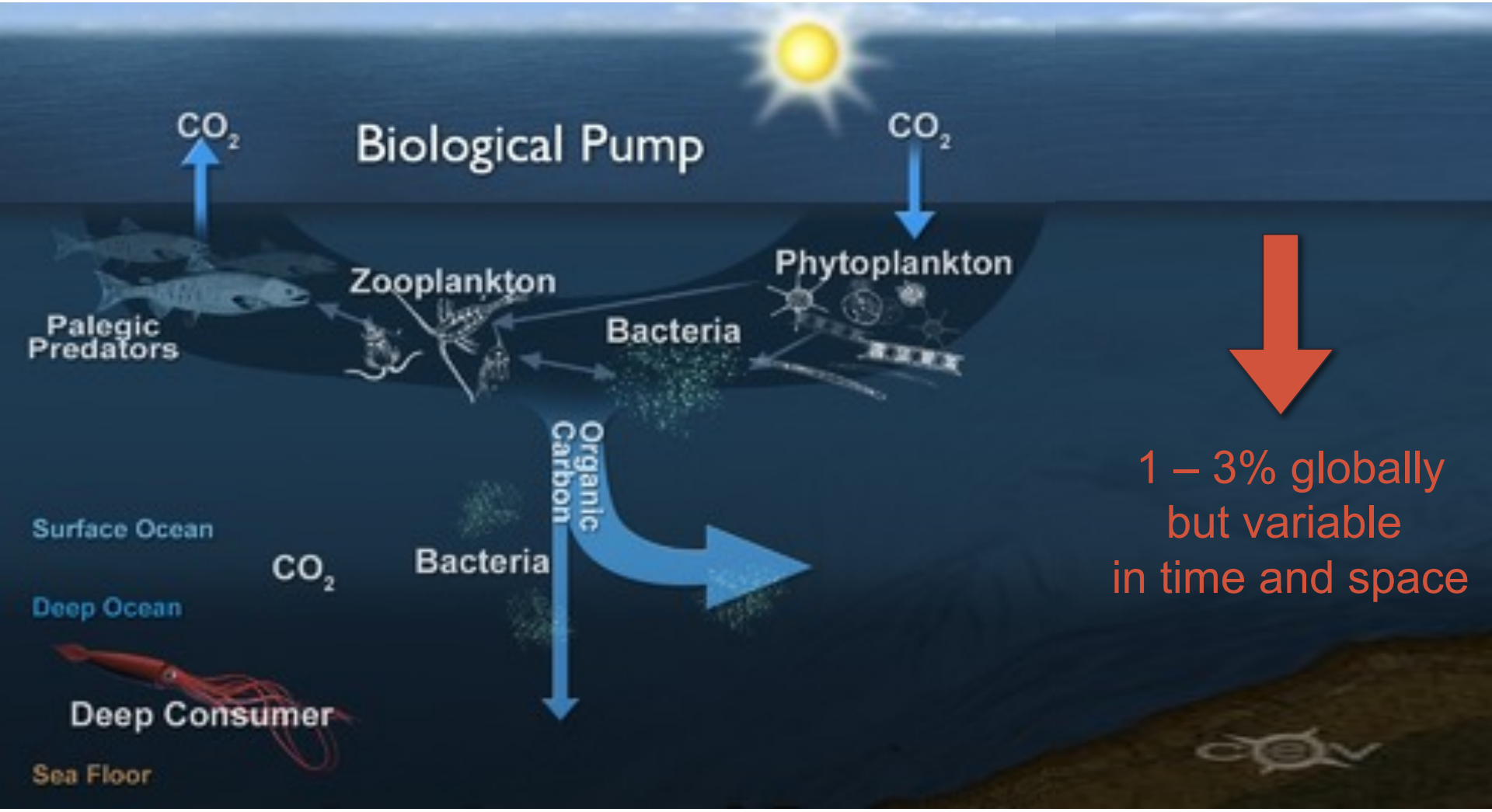
Photosynthesis

…only possible in the euphotic zone

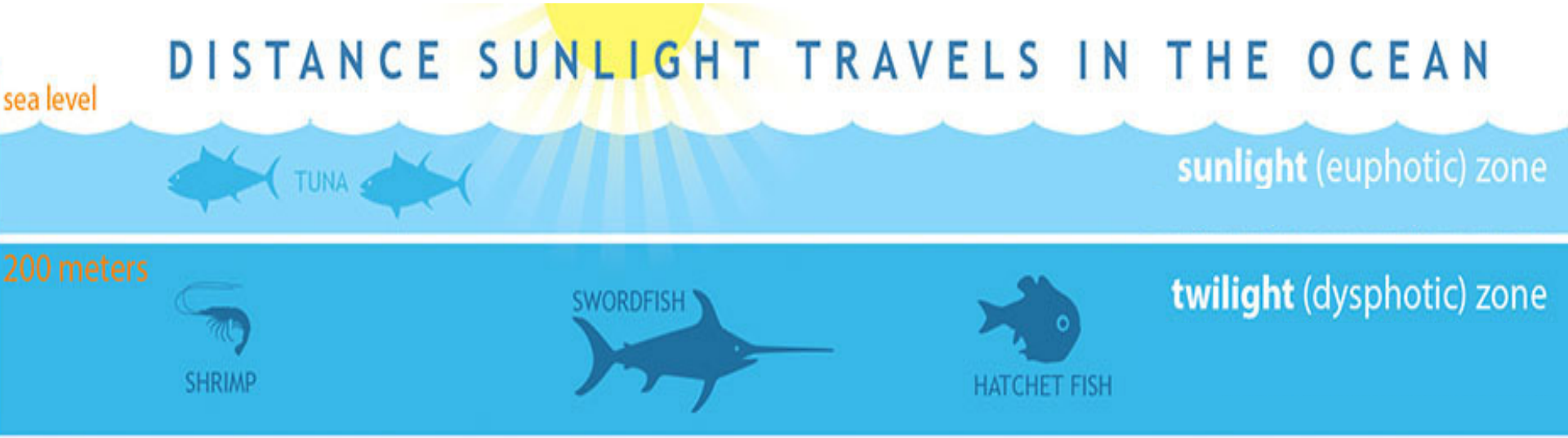


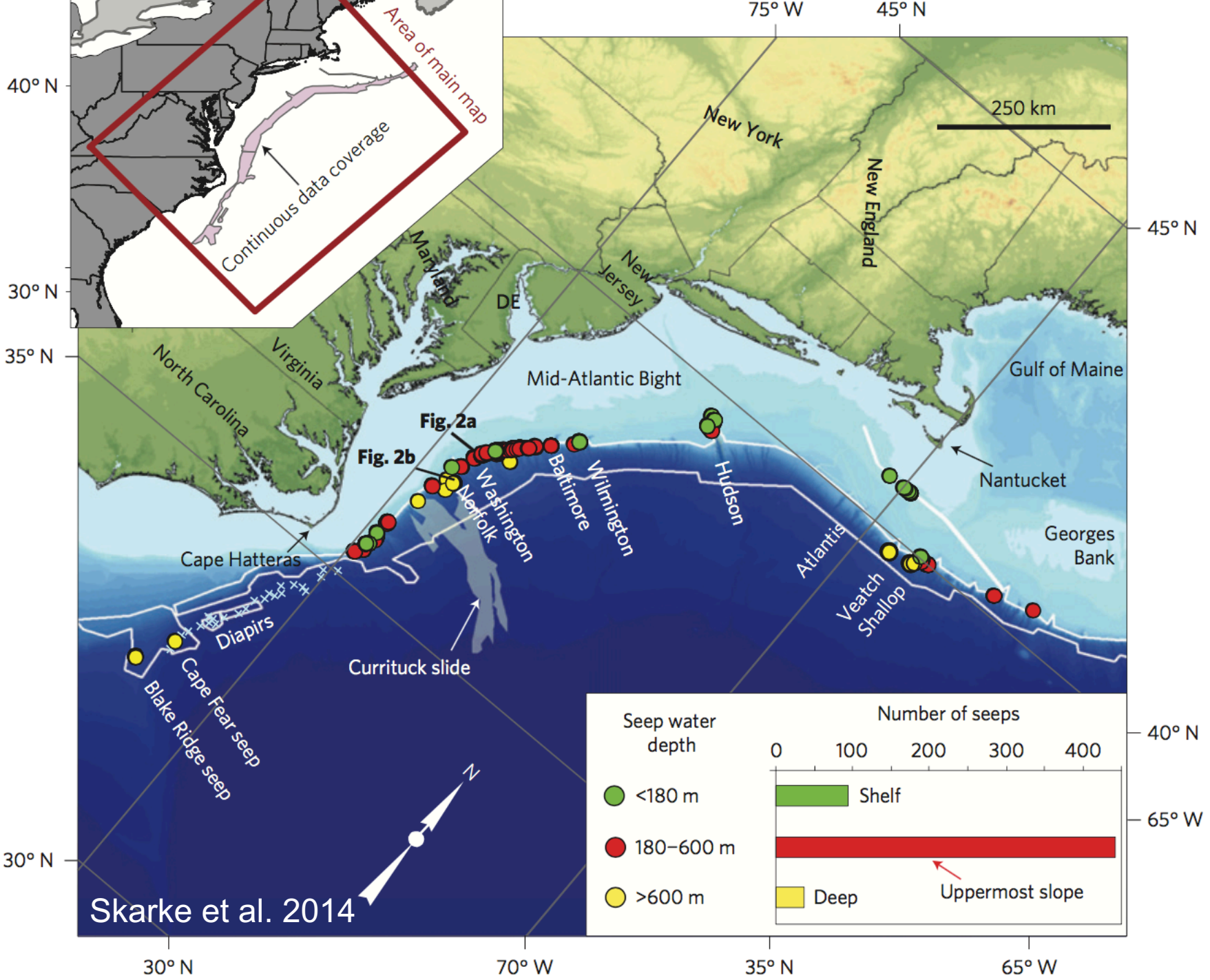
Particulate Organic Carbon (POC) Flux



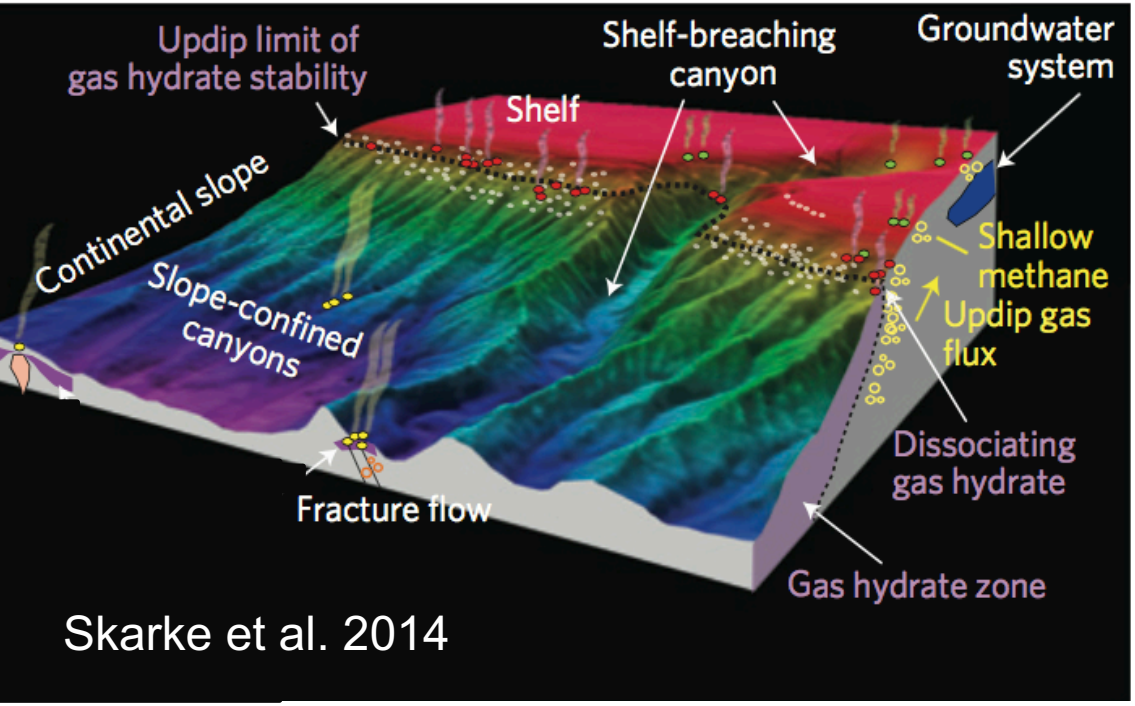
Photosynthesis

…impossible in the deep sea



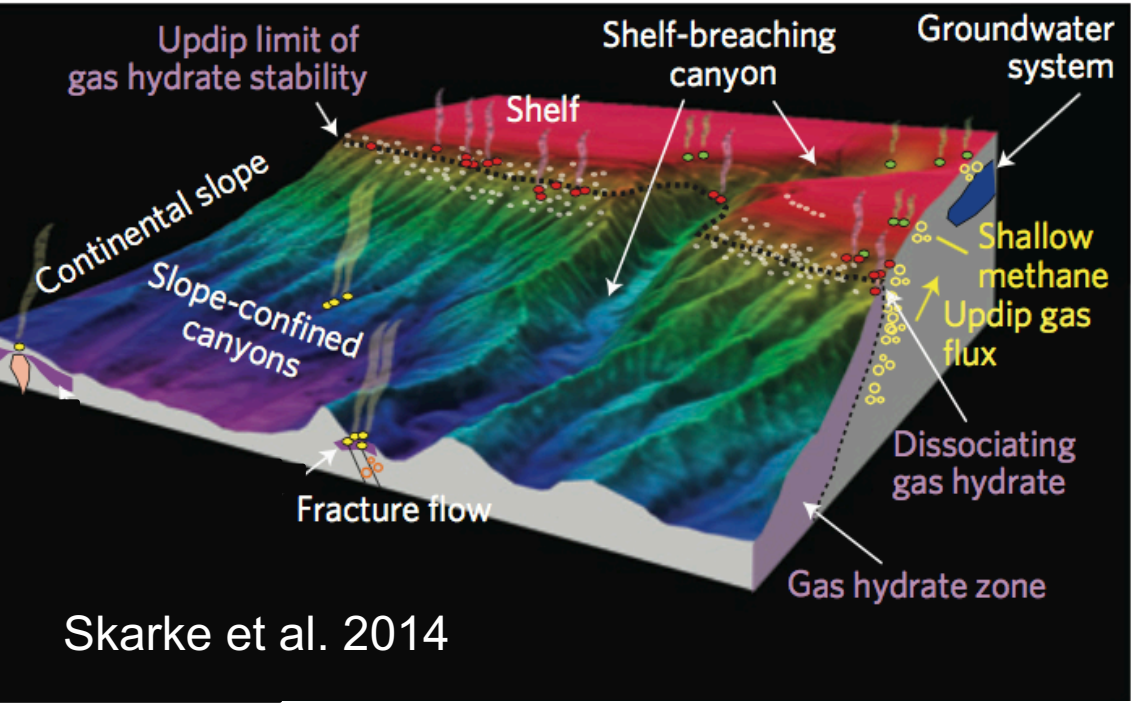

Area of main map
Continuous data coverage
75° W
45° N
40° N
30° N
35° N
250 km
New York
New England
New Jersey
Maryland
DE
Virginia
North Carolina
Mid-Atlantic Bight
Gulf of Maine
Fig. 2a
Fig. 2b
Baltimore
Wilmington
Washington
Norfolk
Hudson
Nantucket
Georges Bank
Atlantis
Veatch Shallop
Cape Hatteras
Diapirs
Currituck slide
Cape Fear seep
Blake Ridge seep
Seep water depth
<180 m
180–600 m
>600 m
Number of seeps
0
100
200
300
400
Shelf
Deep
Uppermost slope
N
70° W
65° W
Skarke et al. 2014

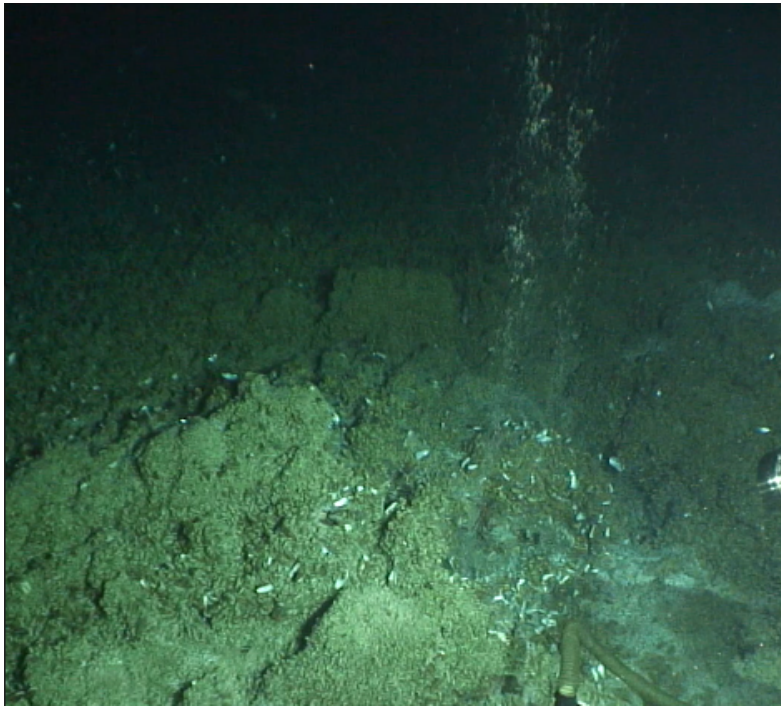
Cold / Methane Seeps



Occur where methane can be a gas,
mostly 180 – 600m depth on Western Atlantic Margin

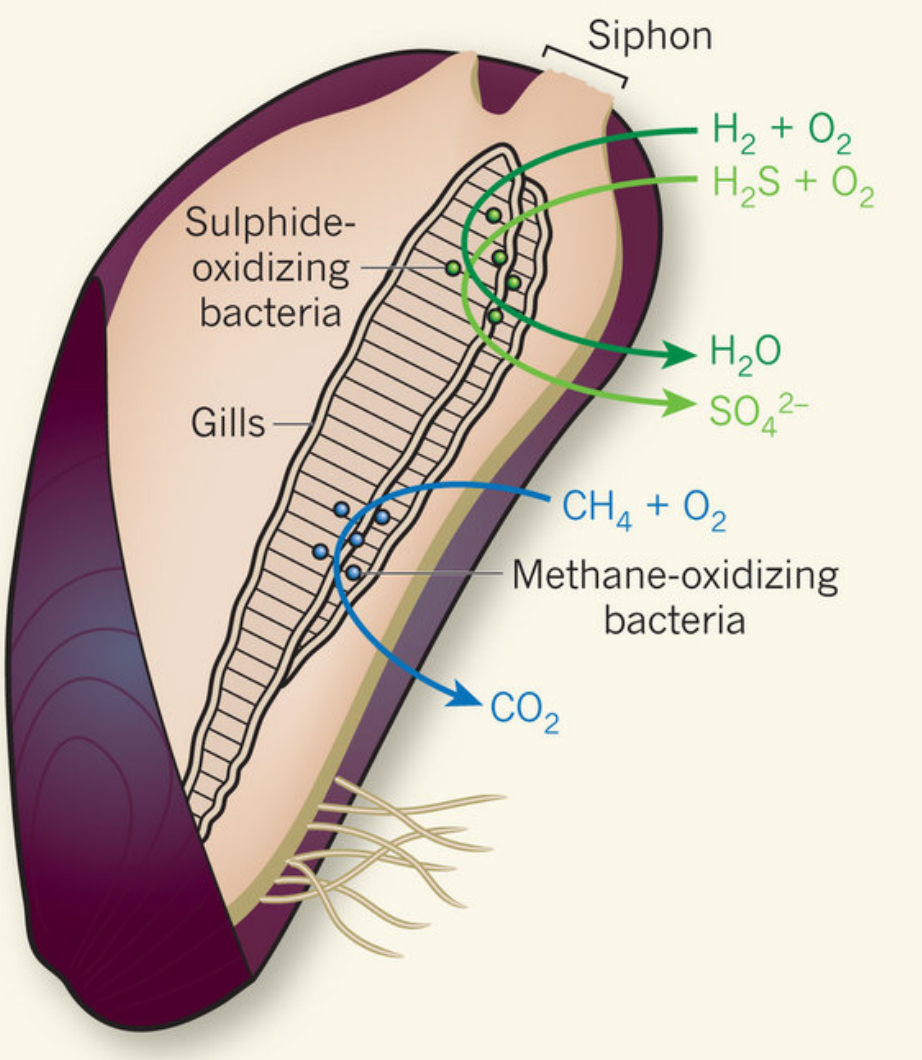
Cold / Methane Seeps





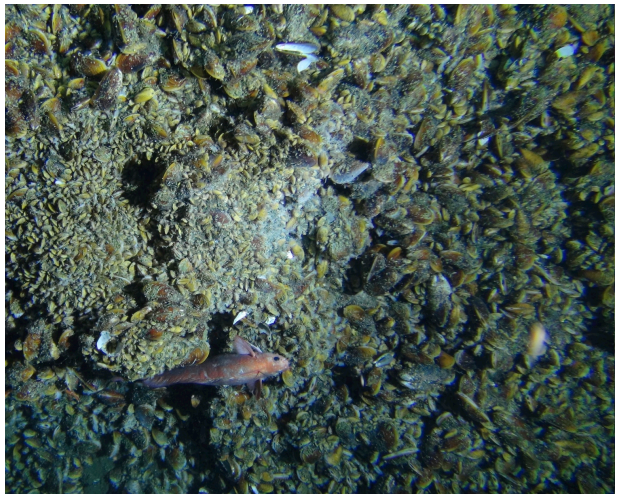
Occur where methane can be a gas,
mostly 180 – 600m depth on Western Atlantic Margin

Cold Seep Chemosynthesis

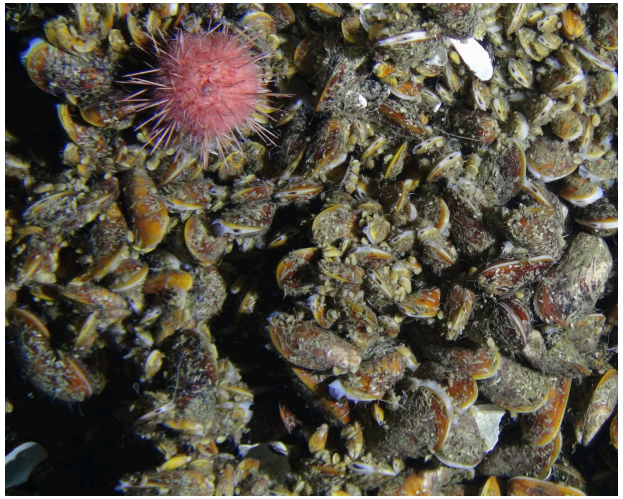


Methane (Carbon and Hydrogen Source) → **Efficient!**

Mussel bed and associated fauna



Mussels contain methane-oxidizing symbionts – dominate biomass



SeepC Project

Chris Linder, WHOI

Deep-Sea Red Crab and Seeps

16oz
$25.99

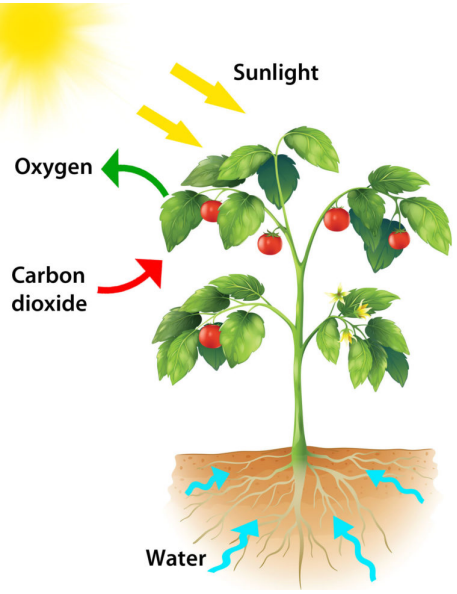
THE ATLANTIC RED CRAB CO.

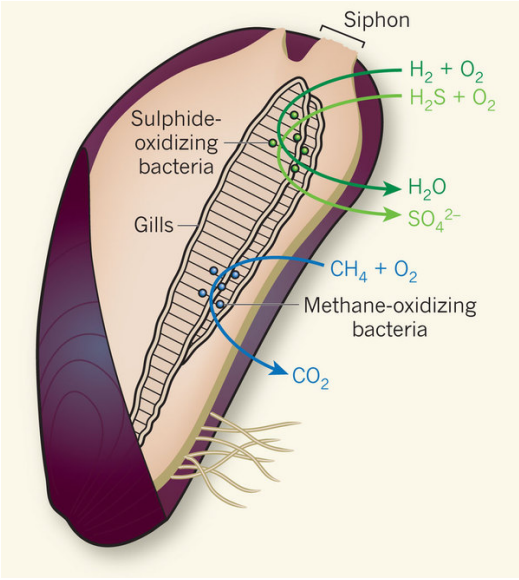
How is this commercial sp. using the chemosynthetic ecosystem?

$\delta^{13}C$: Carbon Isotope Dynamics

Plants preferentially take up ^{12}C

- smaller ^{13}C to ^{12}C ratio
- heavier (less negative) $\delta^{13}C$ signature



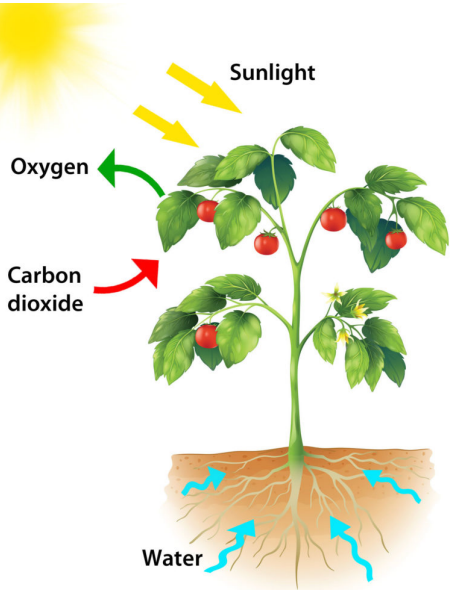


Methane

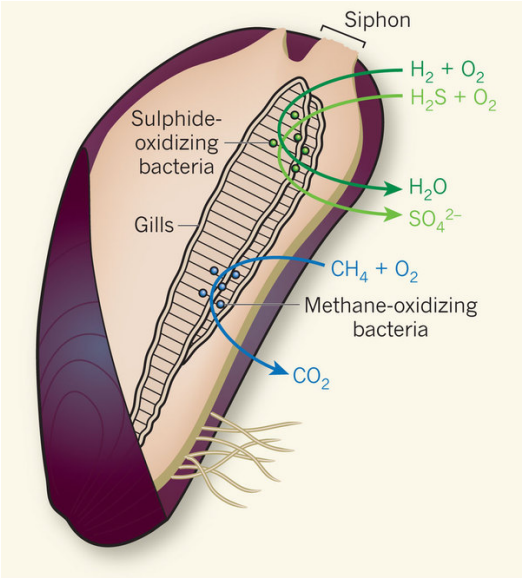
- higher ^{13}C to ^{12}C ratio
- lighter (more negative) $\delta^{13}C$

$\delta^{13}C$: Carbon Isotope Dynamics

Green and Brown Algae
$\delta^{13}C$: -20‰ to -10‰

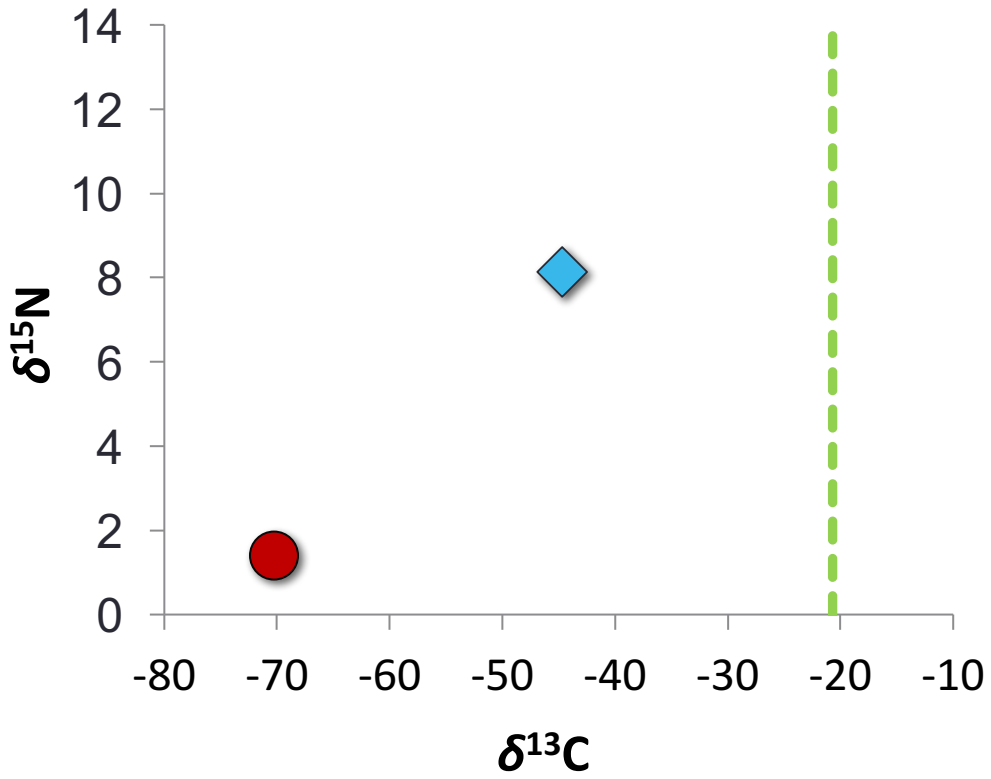


You are the $\delta^{13}C$ that you eat !!!



Biogenic Methane
$\delta^{13}C$: -60‰

$\delta^{13}C$: Chemo- vs. Photo- synthesis



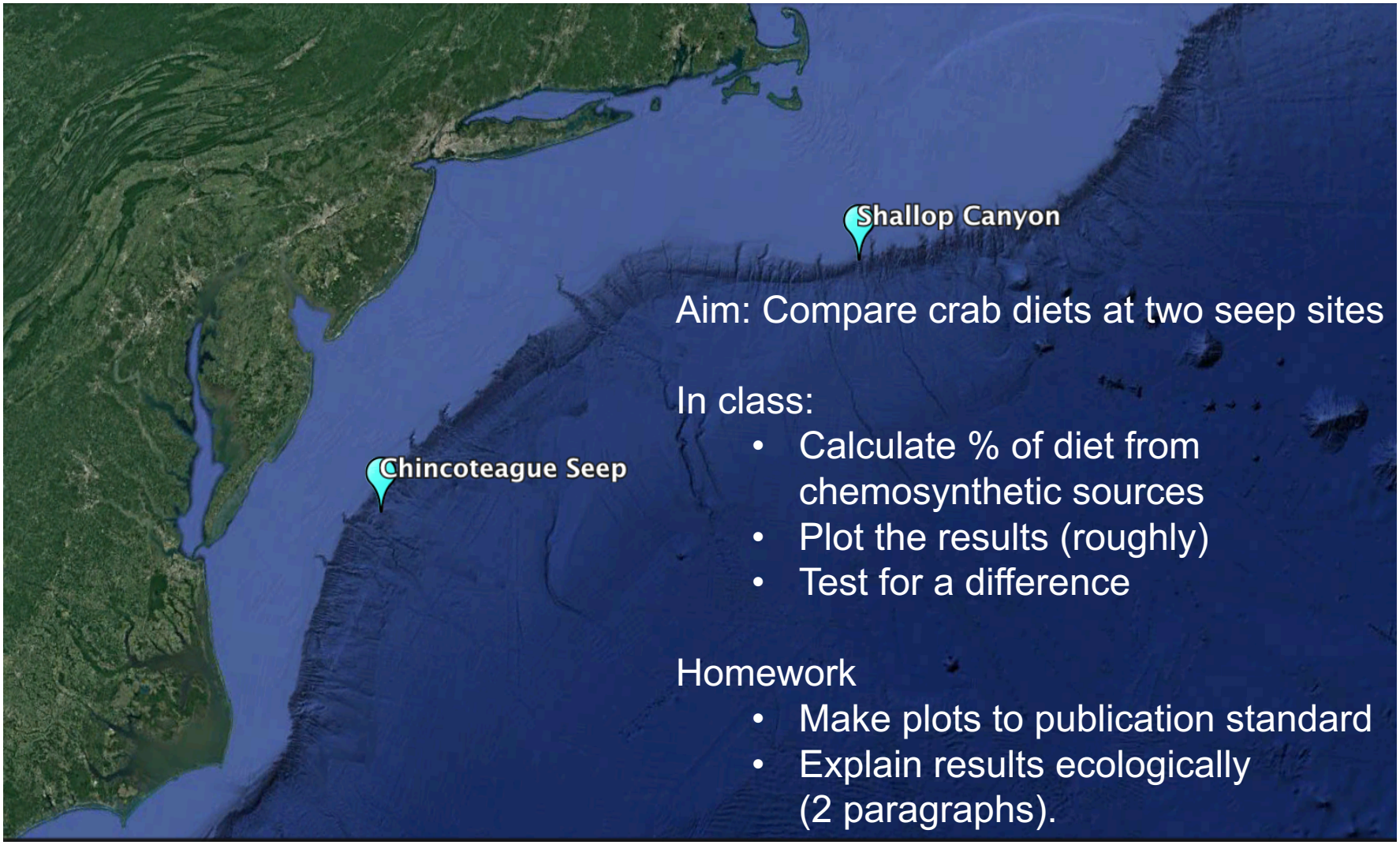
$\delta^{13}C_{Animal} = (\delta^{13}C_{seep} \times f_{seep}) + (\delta^{13}C_{ocean} \times (1 - f_{seep}))$

$f_{seep} = (\delta^{13}C_{Animal} - \delta^{13}C_{ocean}) / (\delta^{13}C_{seep} - \delta^{13}C_{ocean})$

$f_{seep} = (-45 + 20) / (-70 + 20) = -25 / -50 = 0.5$

50% of Diet

Activity #1



Aim: Compare crab diets at two seep sites

In class:

- Calculate % of diet from chemosynthetic sources
- Plot the results (roughly)
- Test for a difference

Homework

- Make plots to publication standard
- Explain results ecologically (2 paragraphs).