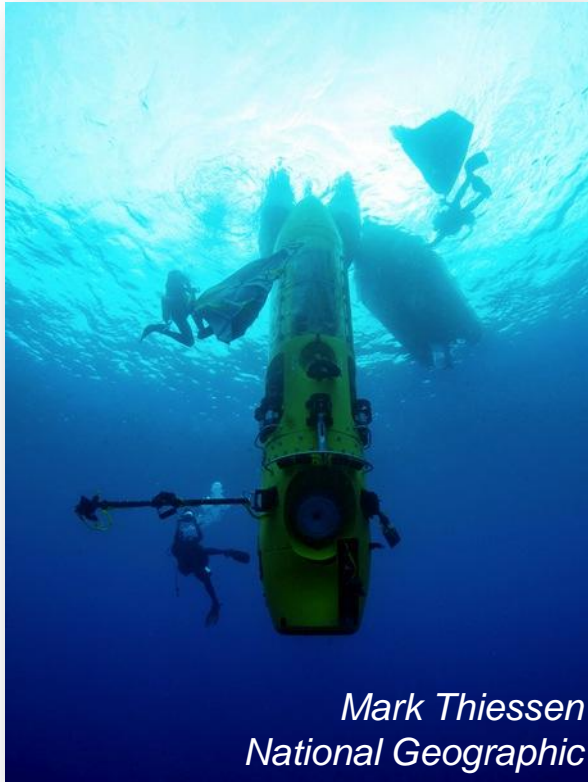


CHARACTERISTICS OF THE DEEP-SEA ENVIRONMENT I

ACCESS – HUMAN-OCCUPIED VEHICLES (HOVS)



*Mark Thiessen
National Geographic*

Deep Challenger



WHOI

Alvin

ACCESS: REMOTELY OPERATED VEHICLES (ROVS)



ROV Jason 2

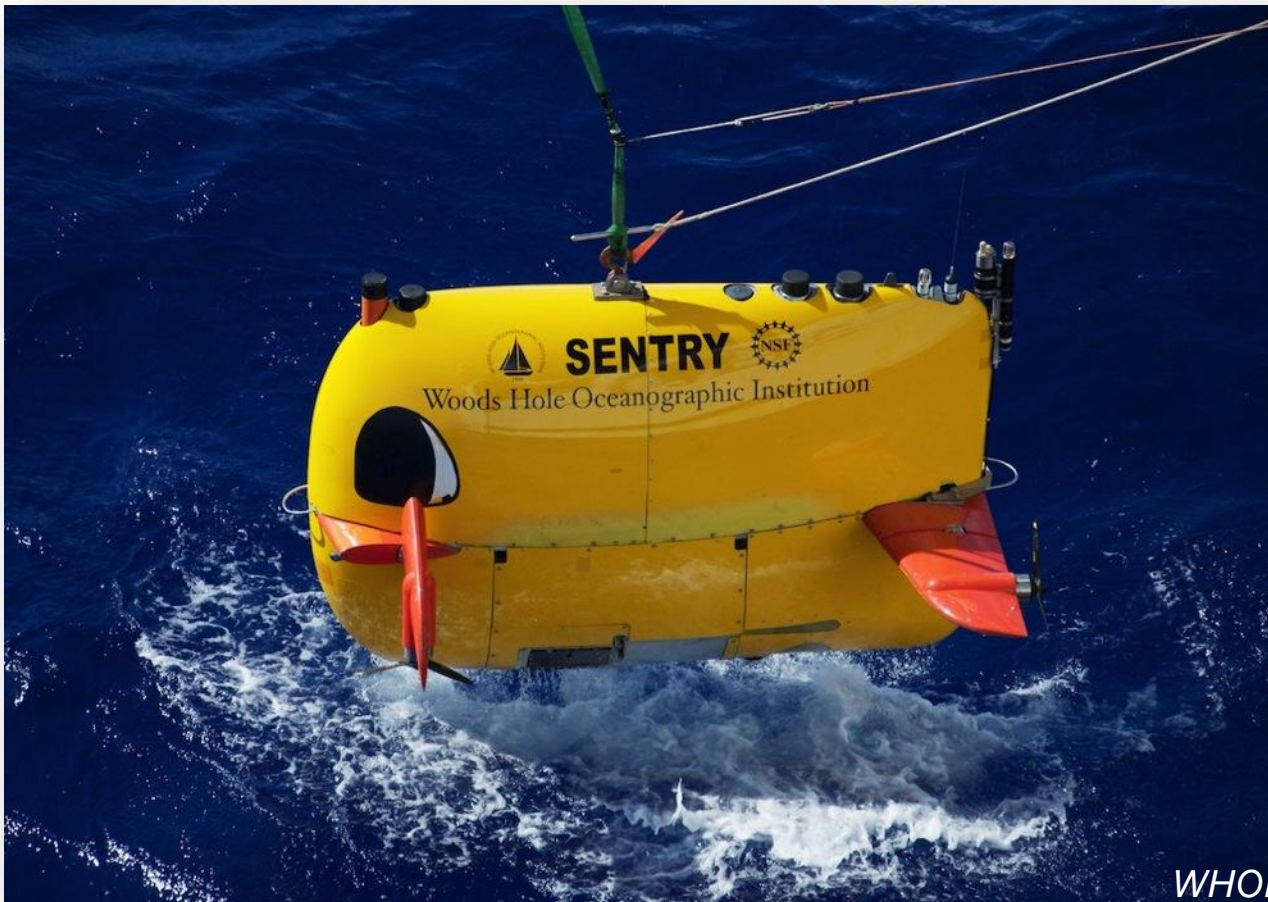


Jason 2 Control Van

ACCESS: REMOTELY OPERATED VEHICLES (ROVS)



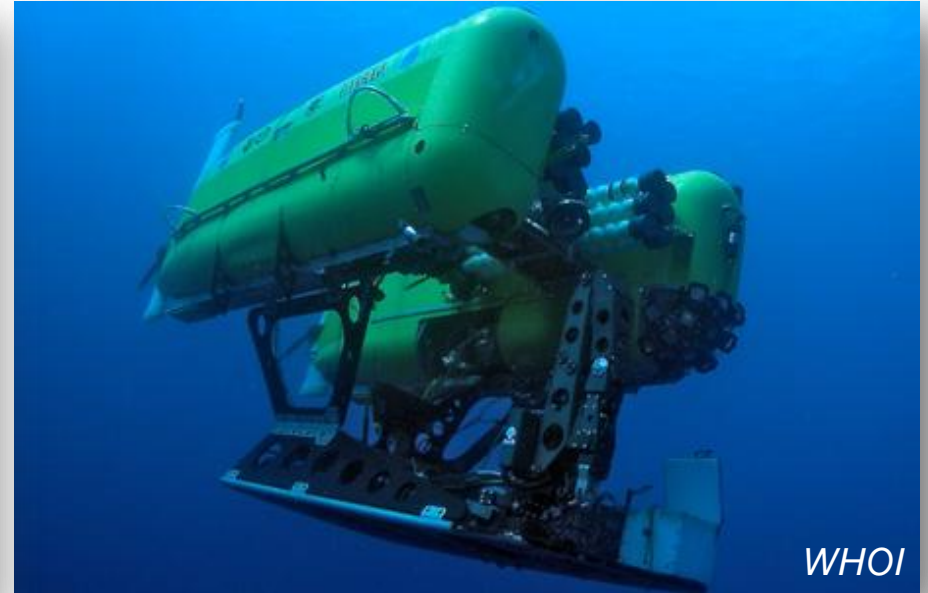
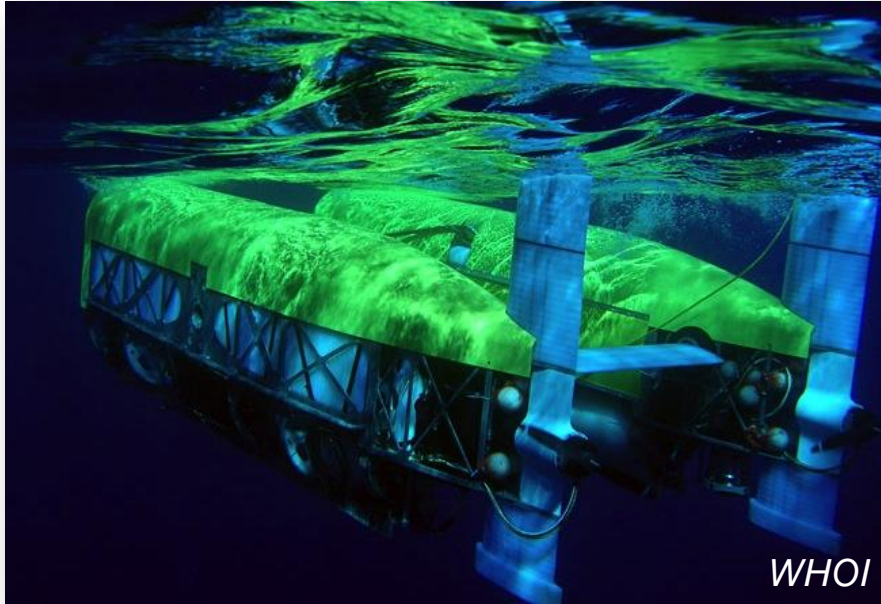
ACCESS: AUTONOMOUS UNDERWATER VEHICLES (AUVS)



WHOI

AUV Sentry

ACCESS: HYBRID ROVS (HROVS)



ACCESS: TELEPRESENCE

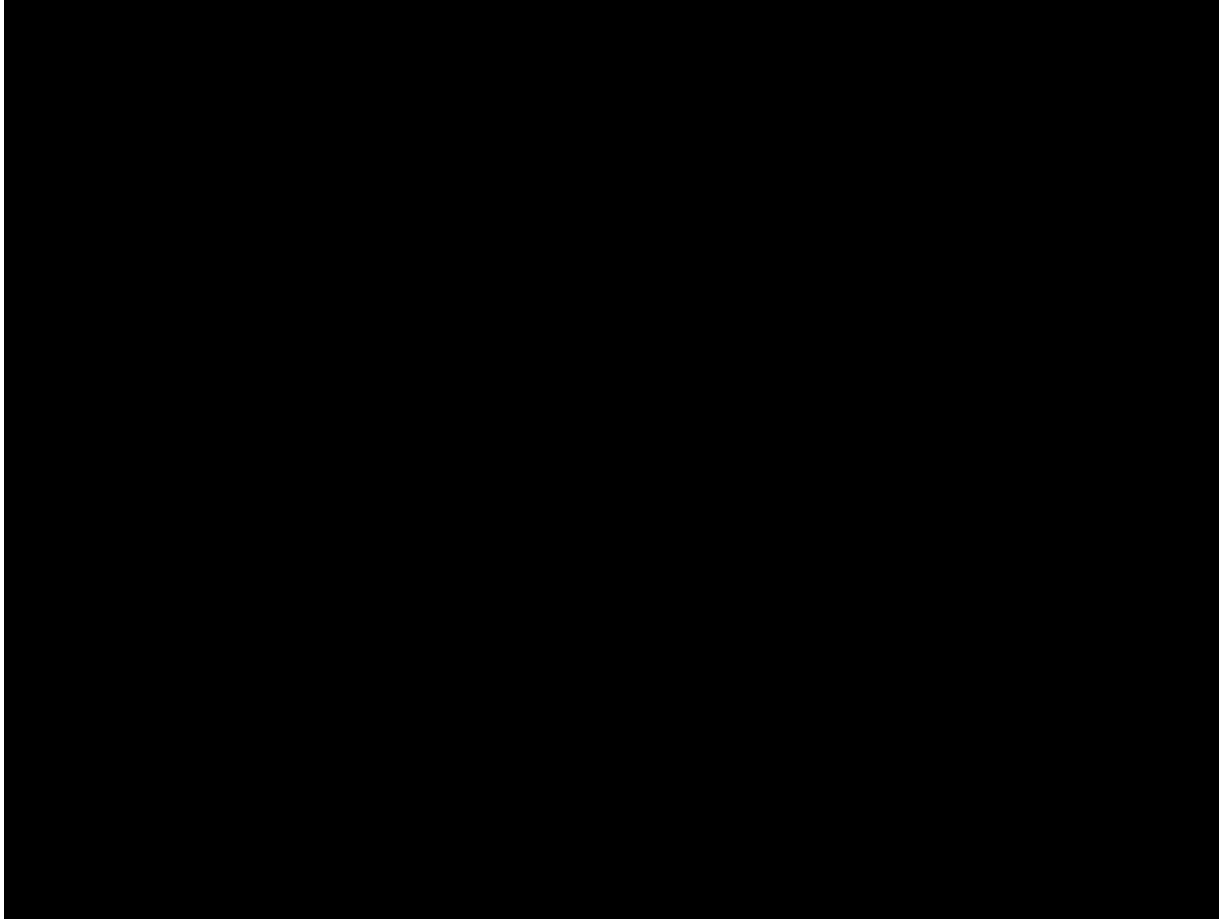


ACCESS: TELEPRESENCE

The screenshot shows the Nautilus Live website. At the top, it features the National Geographic and Sea Research Foundation logos, along with the text "NAUTILUS LIVE" and "Explore the ocean LIVE with Dr. Robert Ballard and his Corps of Explorers aboard EV Nautilus". A navigation menu includes "WATCH LIVE", "THE MISSION", "THE HIGHLIGHTS", "THE TECH", "THE TEAM", "THE LATEST", and "FOR EDUCATORS". Below the menu, there are sections for "FOR KIDS" and "NEW STORIES", with a featured article titled "Vehicles on Deck". The main content area is a large video player showing a live feed of the ocean. To the right of the video player is a sidebar with "CAMERAS" (Channel 1, Channel 2, Quad) and "PARTICIPATE" options. At the bottom, there are three vehicle icons: "EV Nautilus SHIP OF EXPLORATION", "ROV Hercules REMOTELY OPERATED VEHICLE", and "ROV Argus REMOTELY OPERATED VEHICLE".

The screenshot shows a YouTube video player. The video is titled "FK008 - Nereus Dive 55 PART 1 - Oases 2013 - 21 June" and is from the channel "Schmidt Ocean Institute Photos". The video has 824 views and 1 like. The video content shows a live feed from a ship, with a yellow buoy and a white cage visible in the water. The video player includes a progress bar, volume control, and a "Subscribe" button. To the right of the video player is a list of related videos, including "FK008 - Nereus Dive 55 PART II - Oases 2013 - 21 June", "FK008 - Nereus Dive 058 PART III - Oases 2013 - 24 June", "FK008 - Nereus Dive 056 PART 1 - Oases 2013 - 22 June", "FK008 - Nereus Dive 061 PART III - Oases 2013 - 27 June", "FK008 - Nereus Dive 062 PART II - Oases 2013 - 28 June", "FK008 - Nereus Dive 059 PART II - Oases 2013 - 25 June", and "FK008 - Nereus Dive 060 PART II - Oases 2013 - 26 June".

SAMPLING



Field campaign supported by NASA and NSF

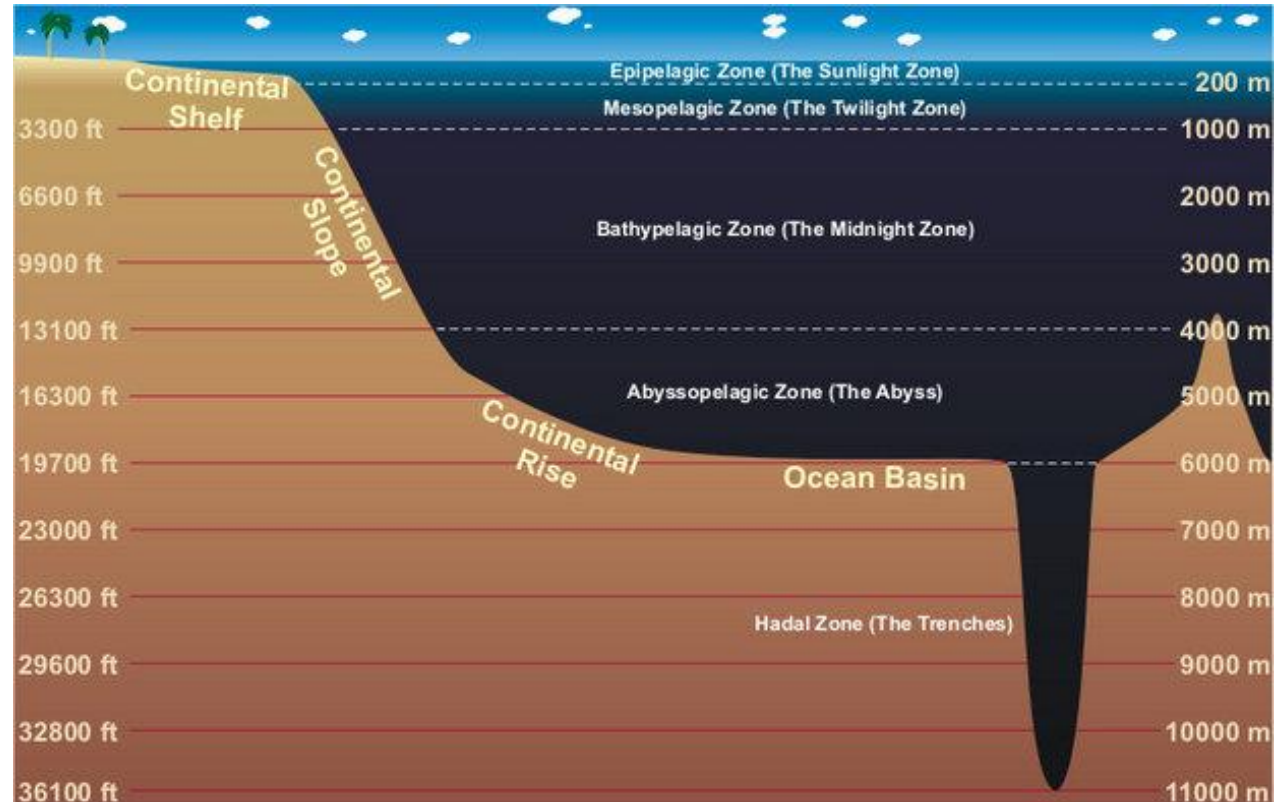
SAMPLE PROCESSING

Time lapse video by Jolene Mok

DEEP-SEA PHYSIOGRAPHY

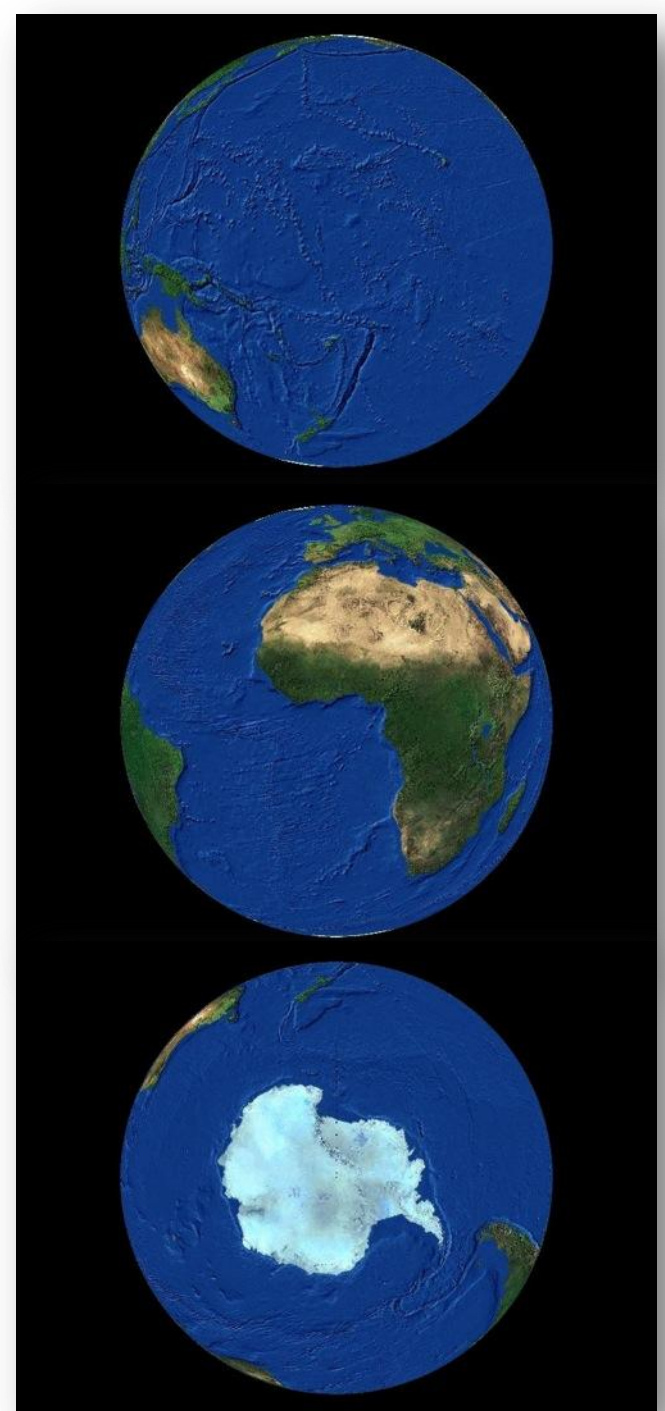
Depth Zonation

- Epipelagic
- Mesopelagic
- Bathypelagic
- Abyssopelagic
- Hadal

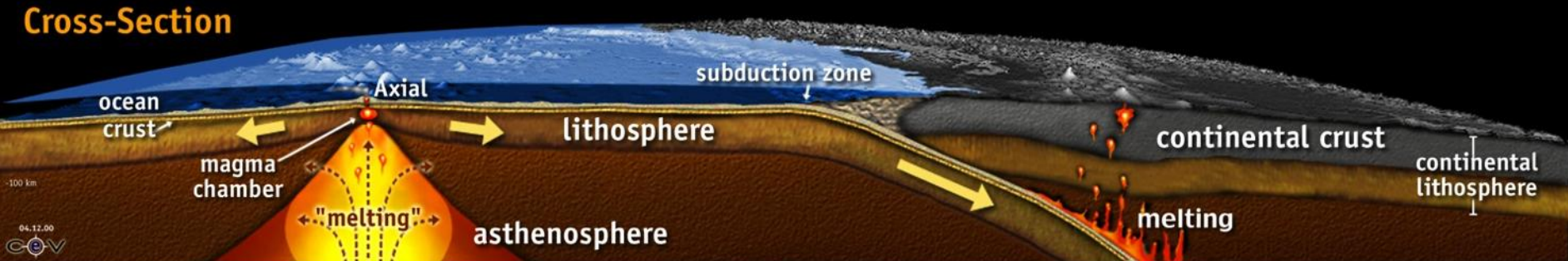


DEEP-SEA PHYSIOGRAPHY

- Mid-ocean ridges
- Subduction zones
- Fracture zones
- Transform faults
- Back-arc basins
- Seamounts
- Abyssal plains
- Canyons
- Shelf and slopes



DEEP-SEA PHYSIOGRAPHY

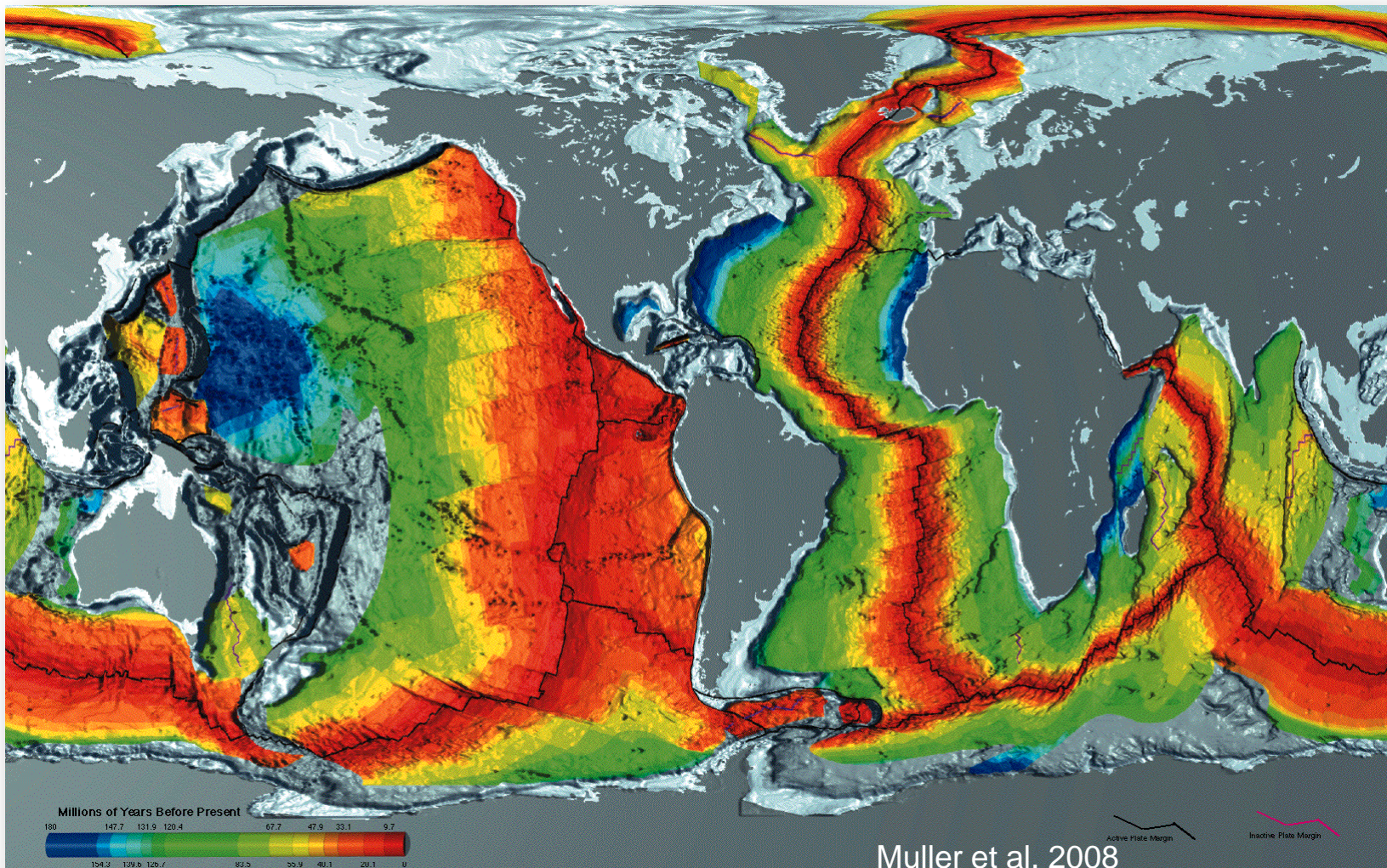


NEPTUNE Project (www.neptune.washington.edu) and The Center for Environmental Visualization

Mid-Ocean Ridges
Subduction Zones

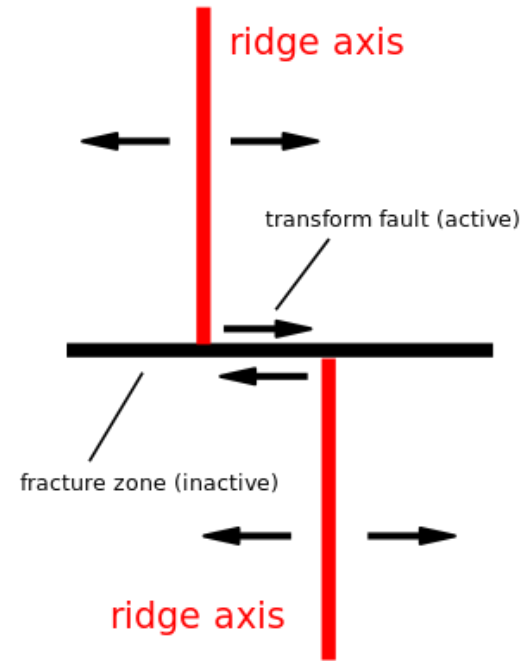
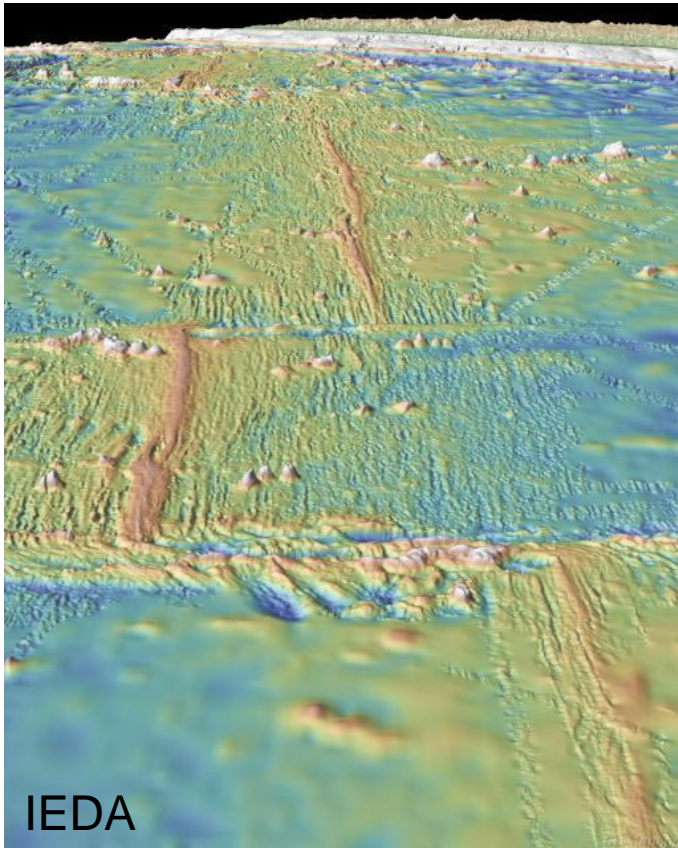
DEEP-SEA PHYSIOGRAPHY

Fast-Spreading Ridges
Slow-Spreading Ridges

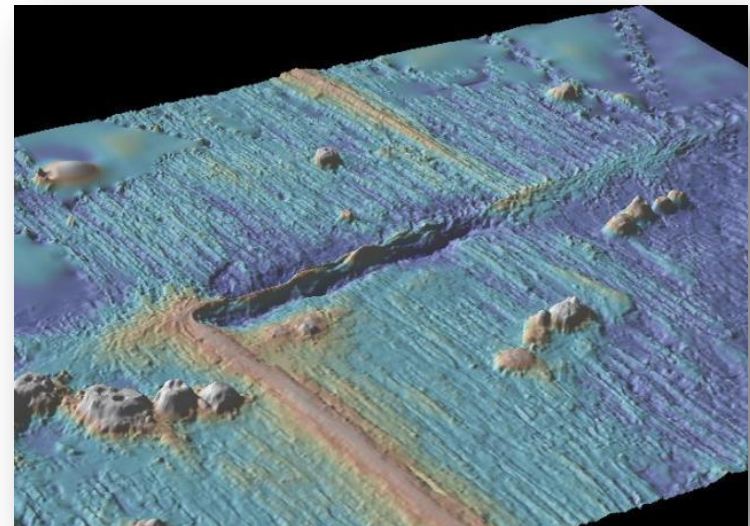


DEEP-SEA PHYSIOGRAPHY

Transform Faults Fracture Zones



Clipperton Transform Fault

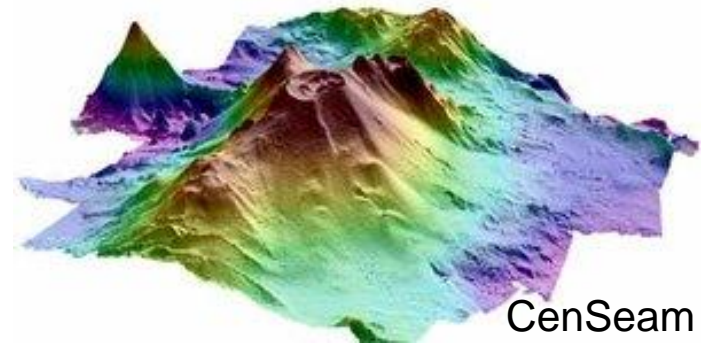


DEEP-SEA PHYSIOGRAPHY

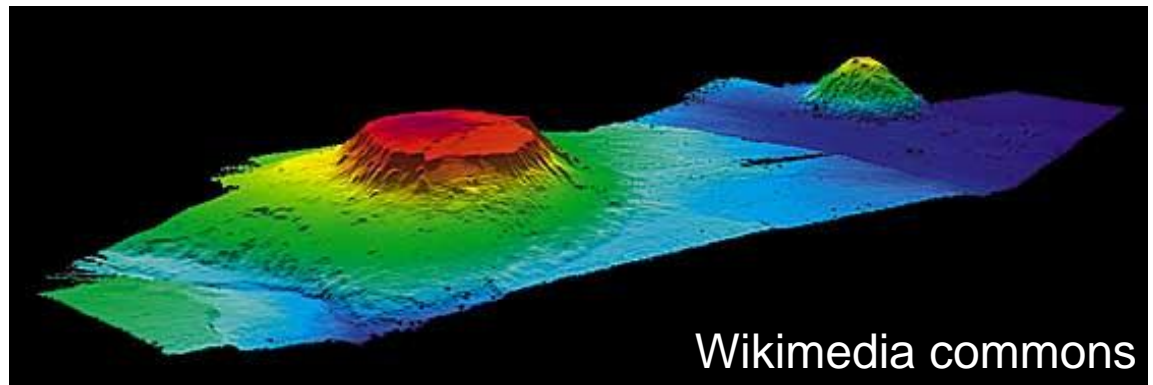
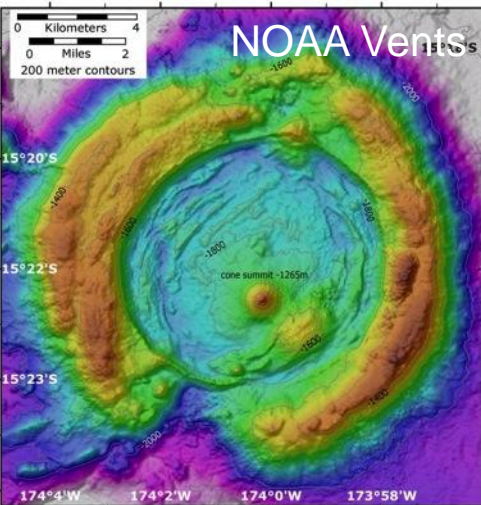
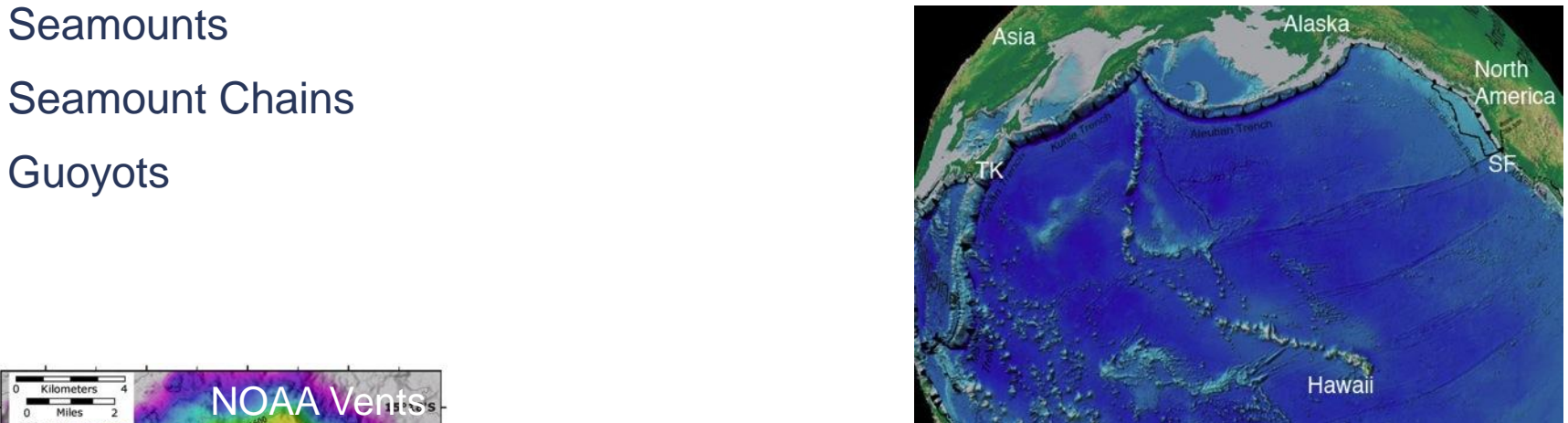
Seamounts

Seamount Chains

Guoyots



CenSeam



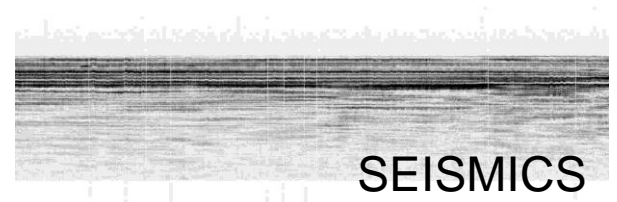
Wikimedia commons

DEEP-SEA PHYSIOGRAPHY

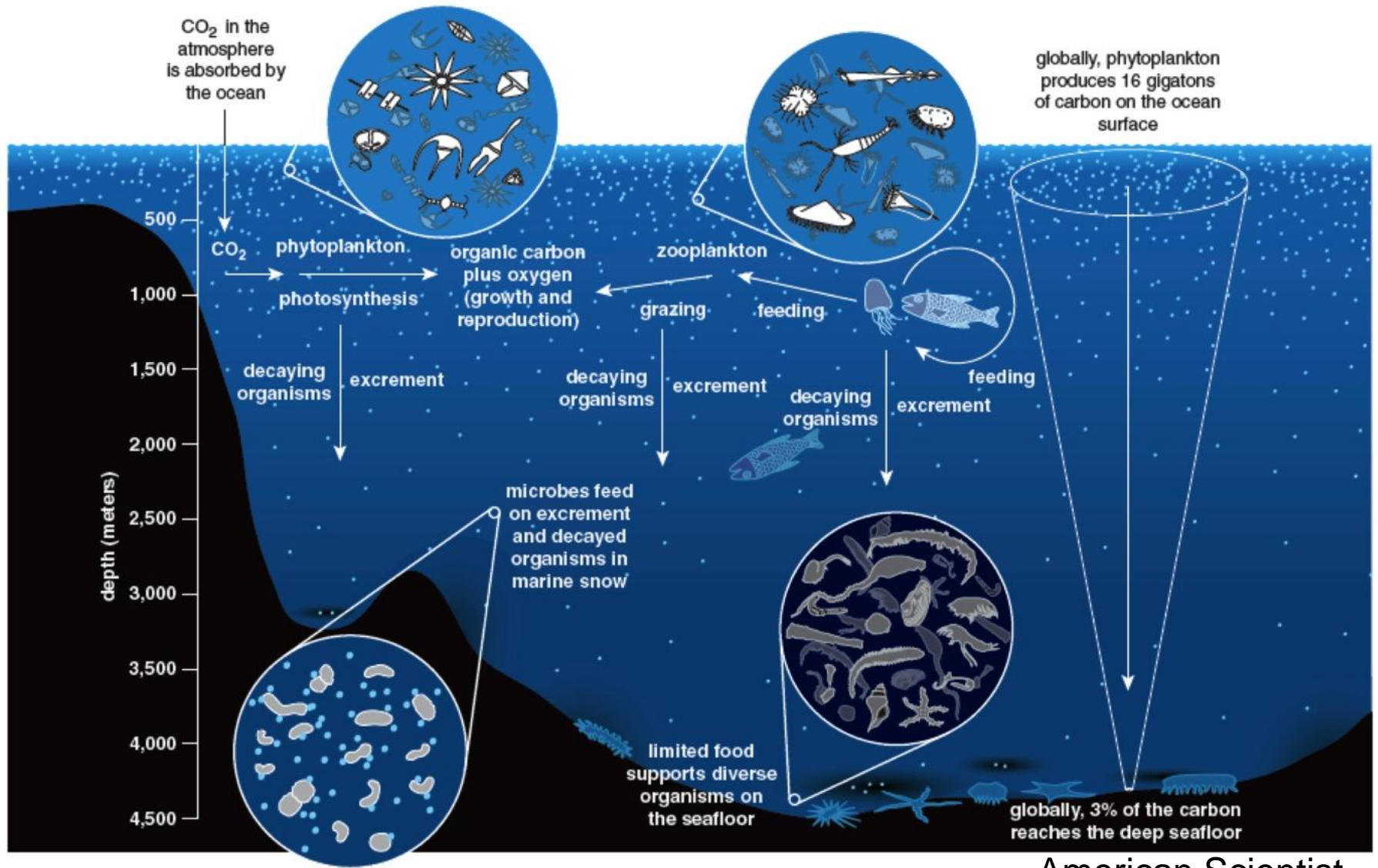
Abyssal Plain



Wikimedia Commons

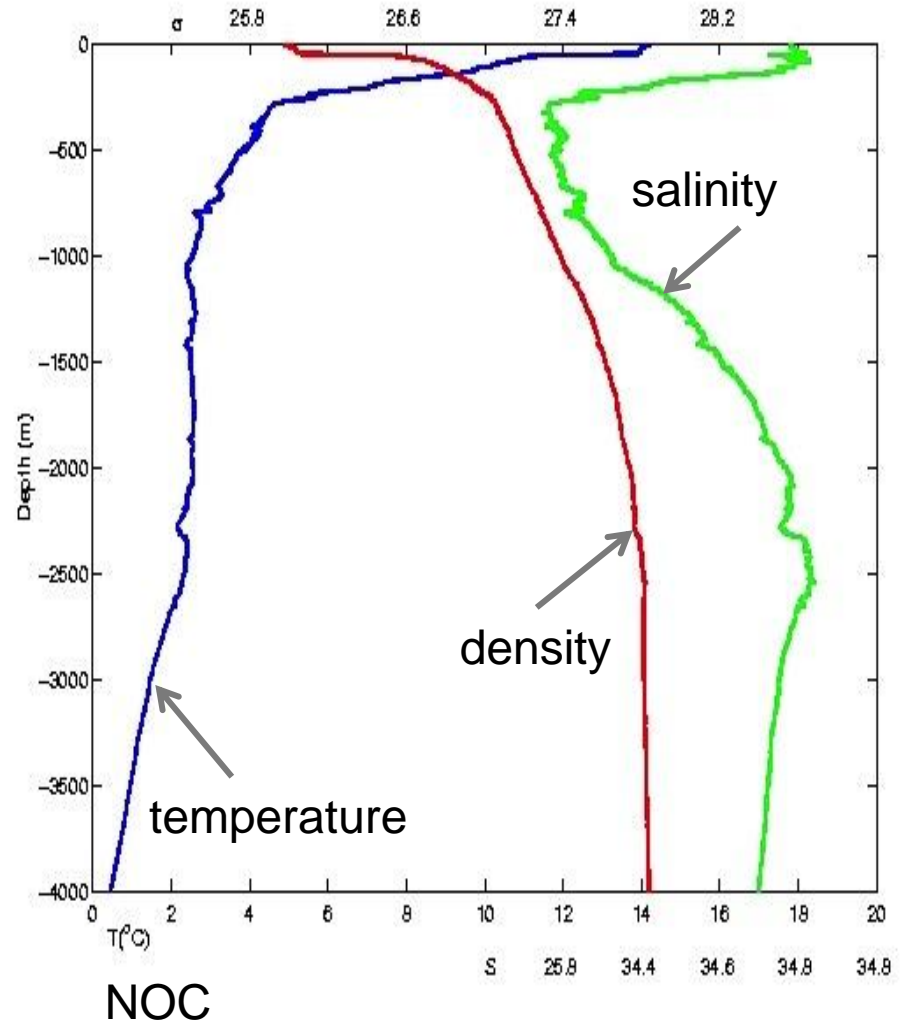
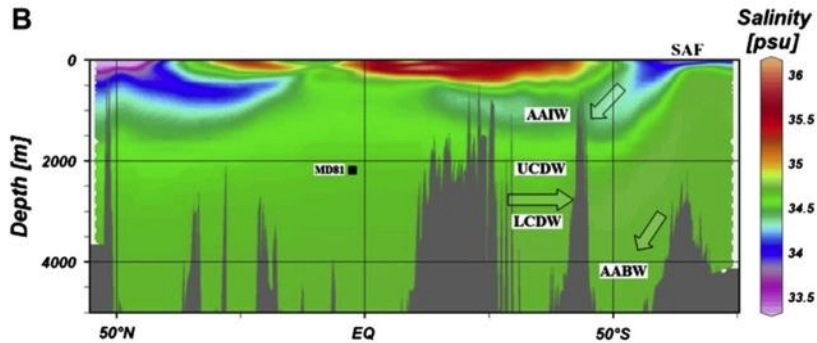
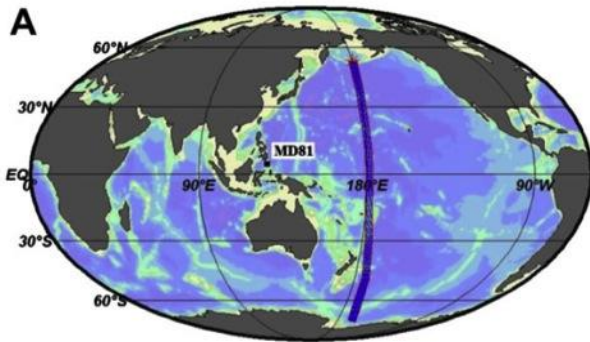


DEEP-SEA ENVIRONMENT



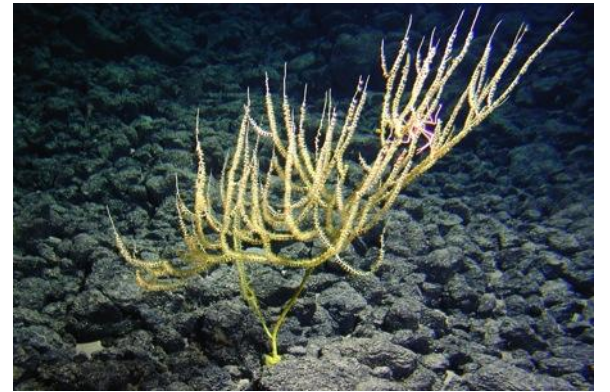
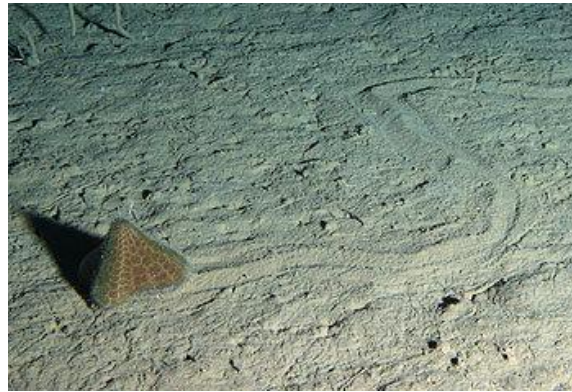
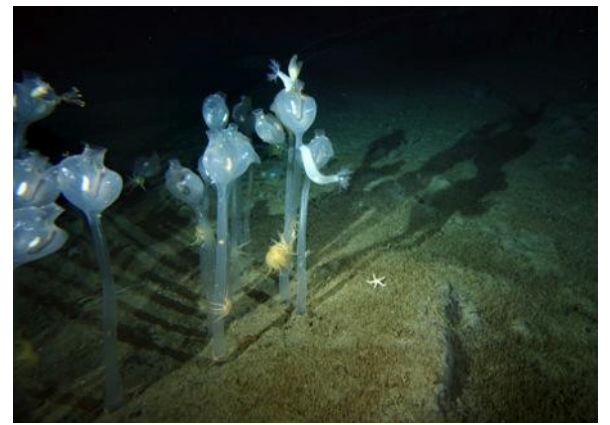
DEEP-SEA ENVIRONMENT

Water Masses
Water Column Profiles



DEEP-SEA ORGANISMS

Megafauna > 2 cm



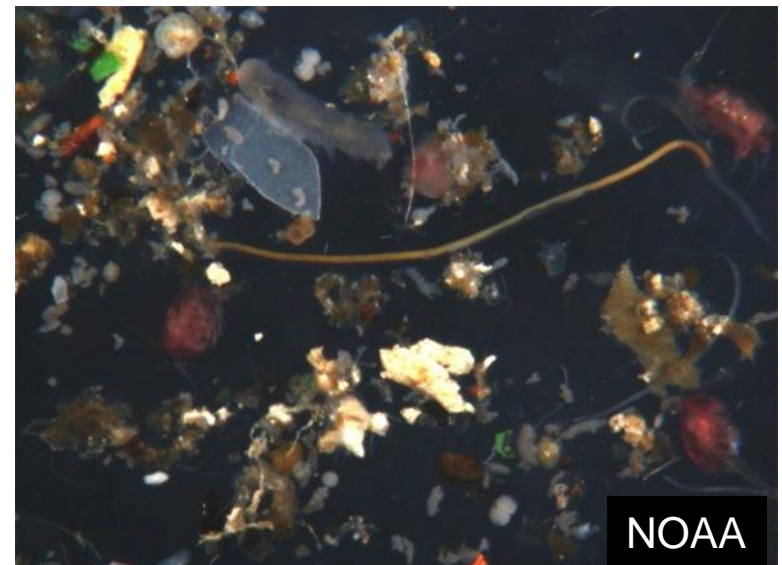
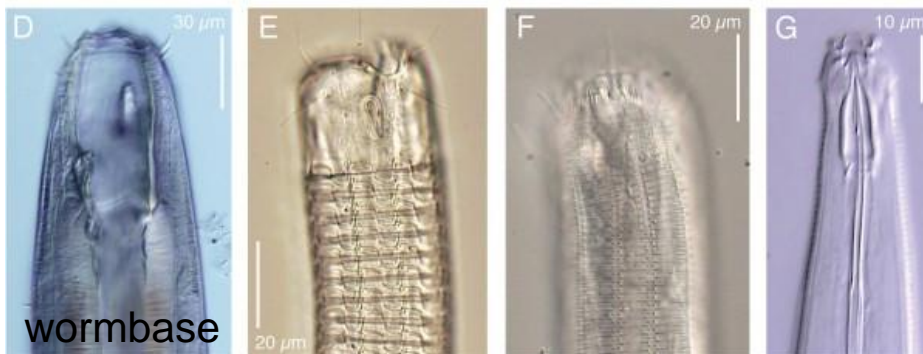
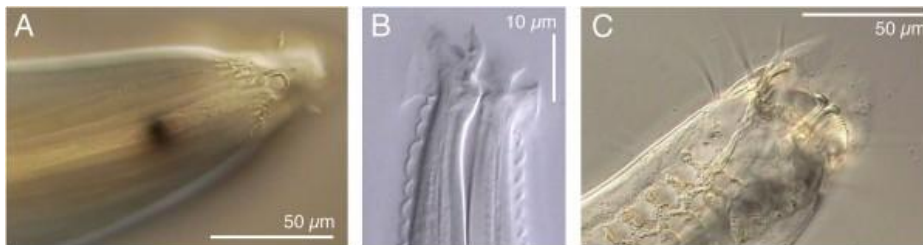
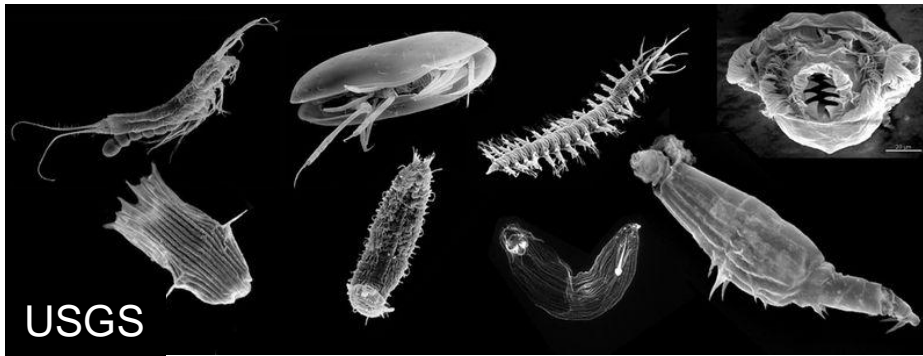
DEEP-SEA ORGANISMS

Macrofauna <2 cm, >250 microns



DEEP-SEA ORGANISMS

Meiofauna <250 microns, > 42 microns



DEEP-SEA ORGANISMS

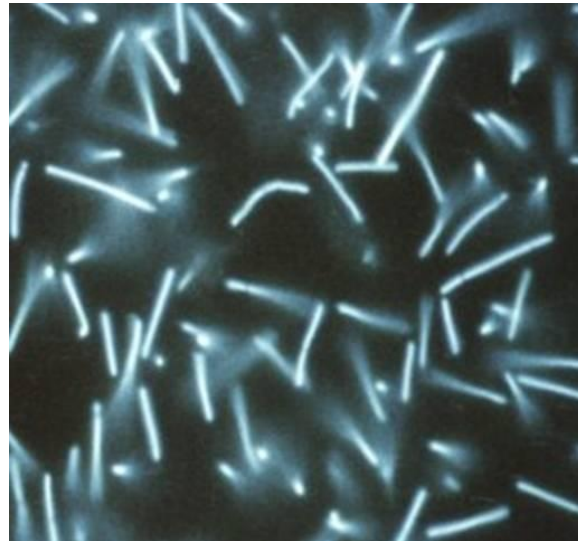
Microorganisms

Protista



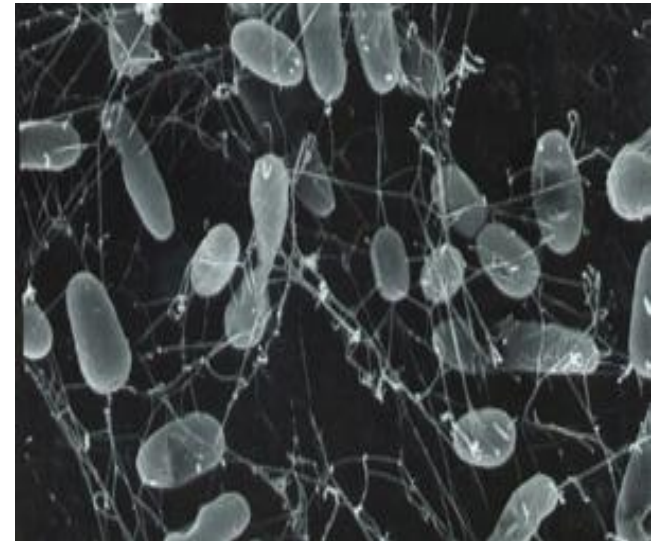
Oceanus

Archaea



A Thurber

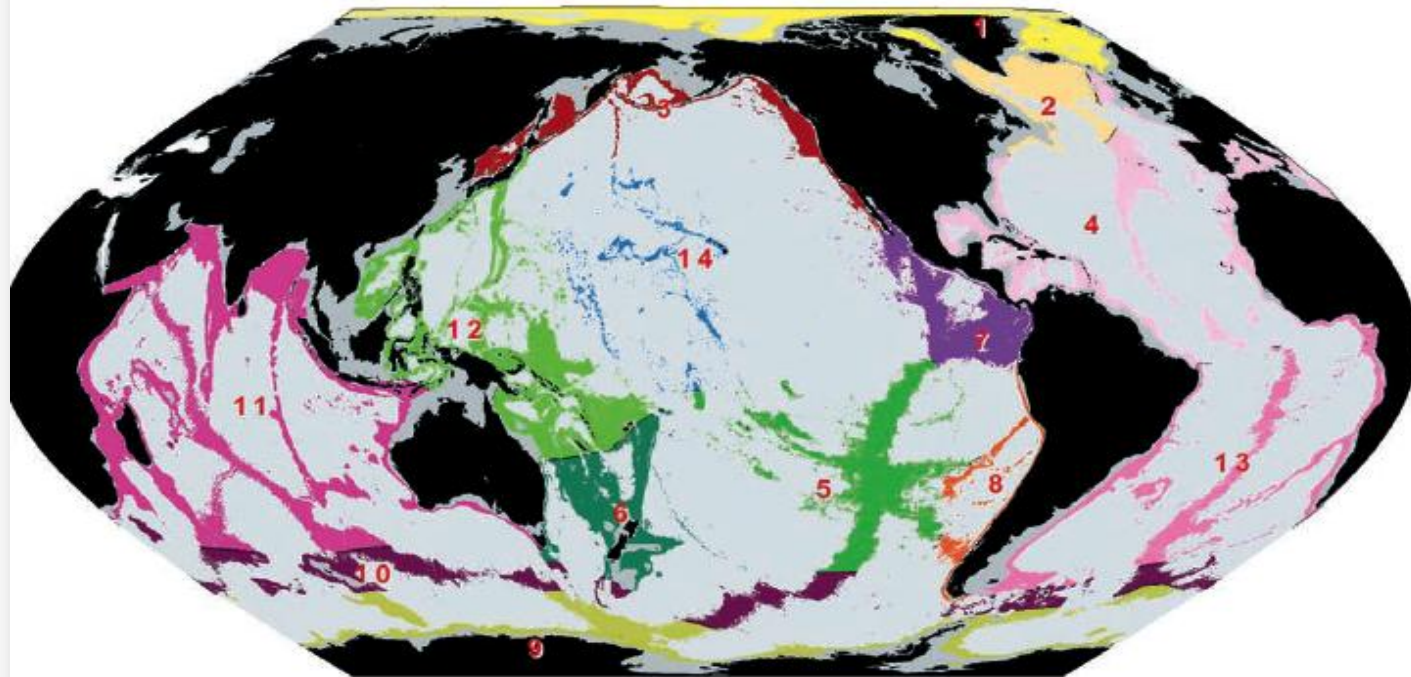
Bacteria



J Huber

DEEP-SEA ZOOGEOGRAPHY

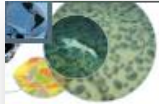
Global Open Oceans and Deep Seabed (GOODS) biogeographic classification
6/benthic systems



- | | | | | |
|----------------------------|-------------------------|----------------|------------------|--------------------|
| 1. Arctic | 4. North Atlantic | 7. Cocos Plate | 10. Subantarctic | 13. South Atlantic |
| 2. Northern North Atlantic | 5. SE Pacific Ridges | 8. Nazca Plate | 11. Indian | 14. North Pacific |
| 3. Northern North Pacific | 6. New Zealand Kermadec | 9. Antarctic | 12. West Pacific | |

FIGURE 7: Lower bathyal provinces. Depth range 800 to 3000m.

DEEP-SEA ZOOGEOGRAPHY



Global Open Oceans and Deep Seabed (GOODS) biogeographic classification
6/benthic systems

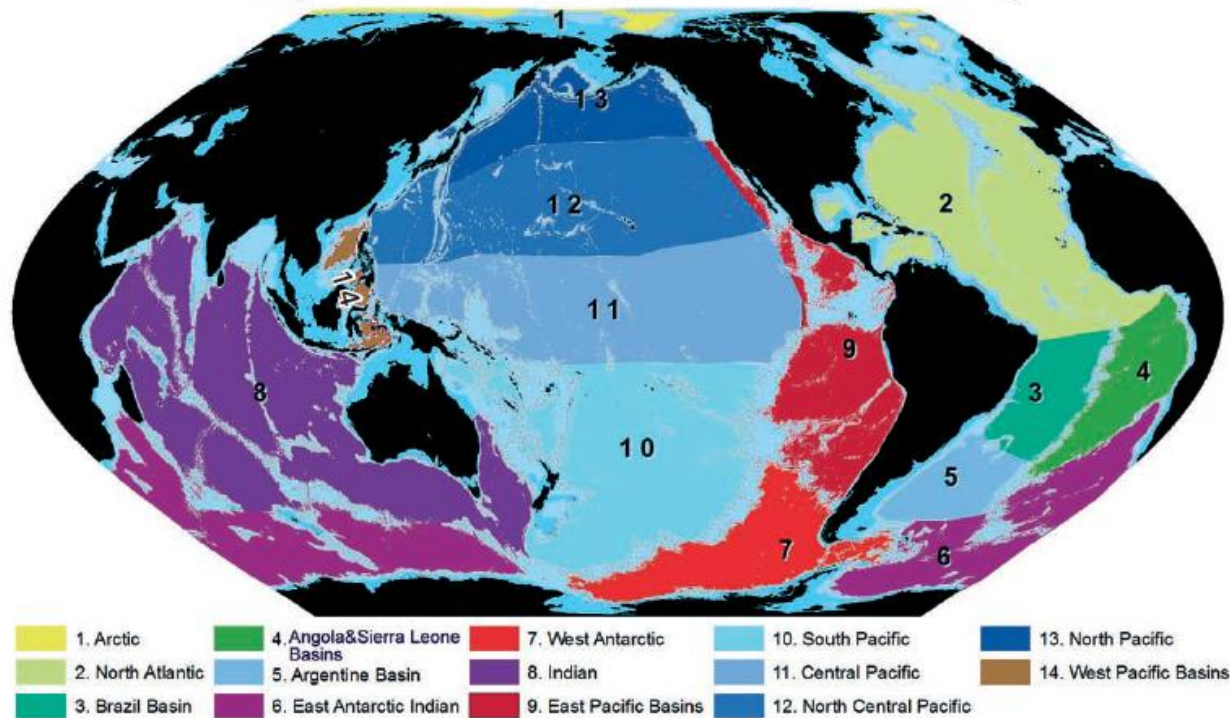
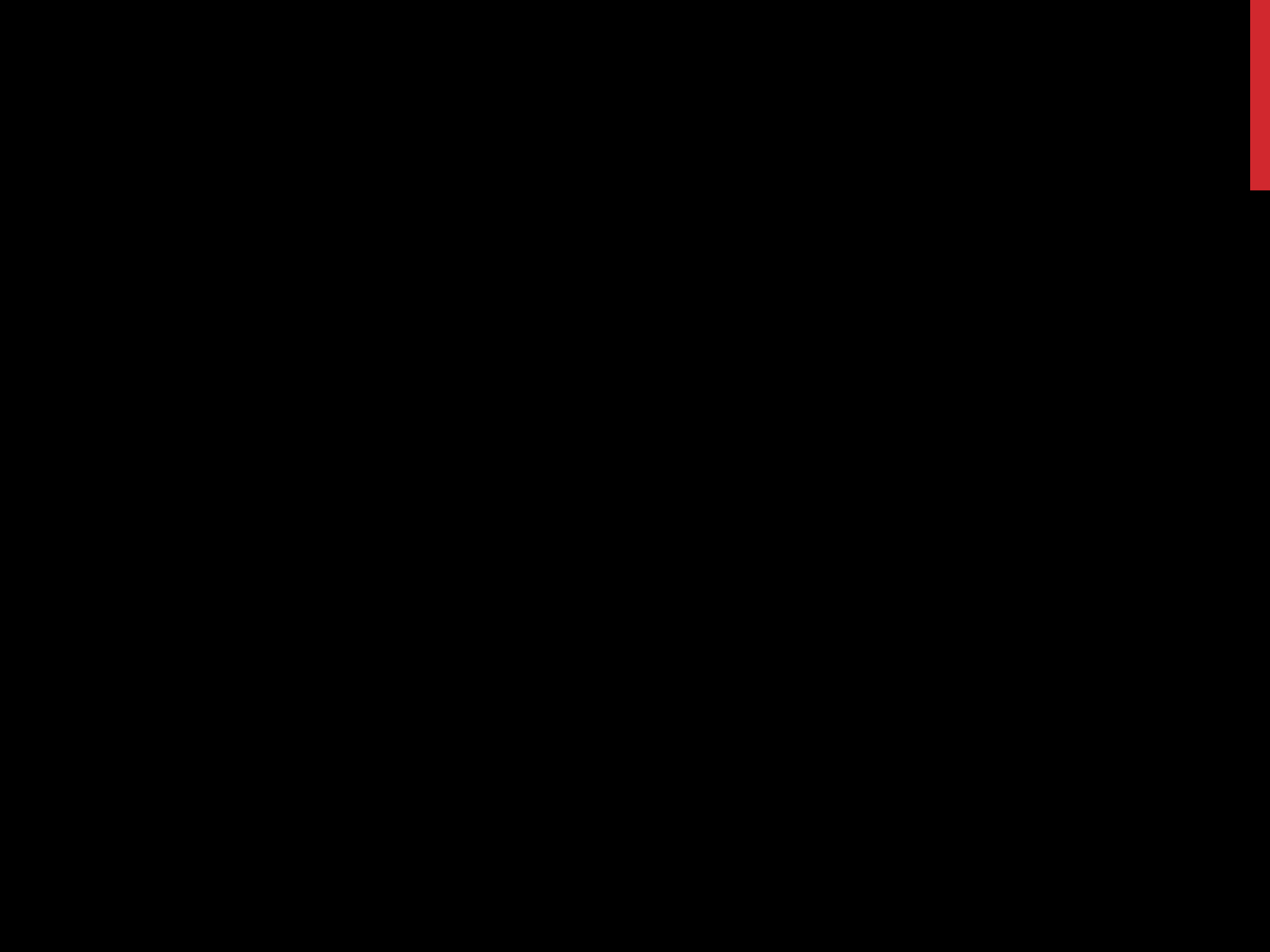


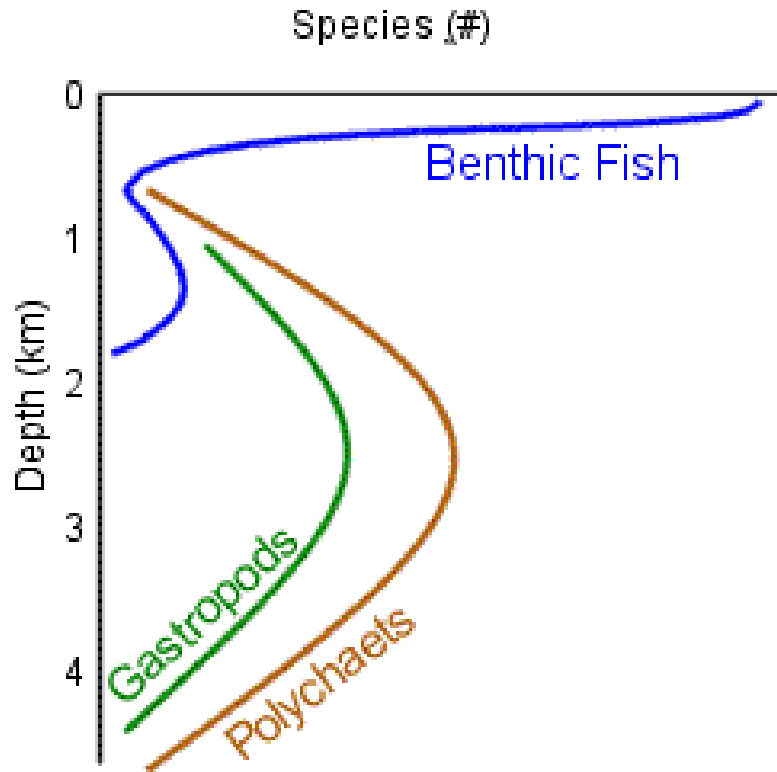
FIGURE 8: Abyssal provinces. Depth range 3500 to 6500 m.



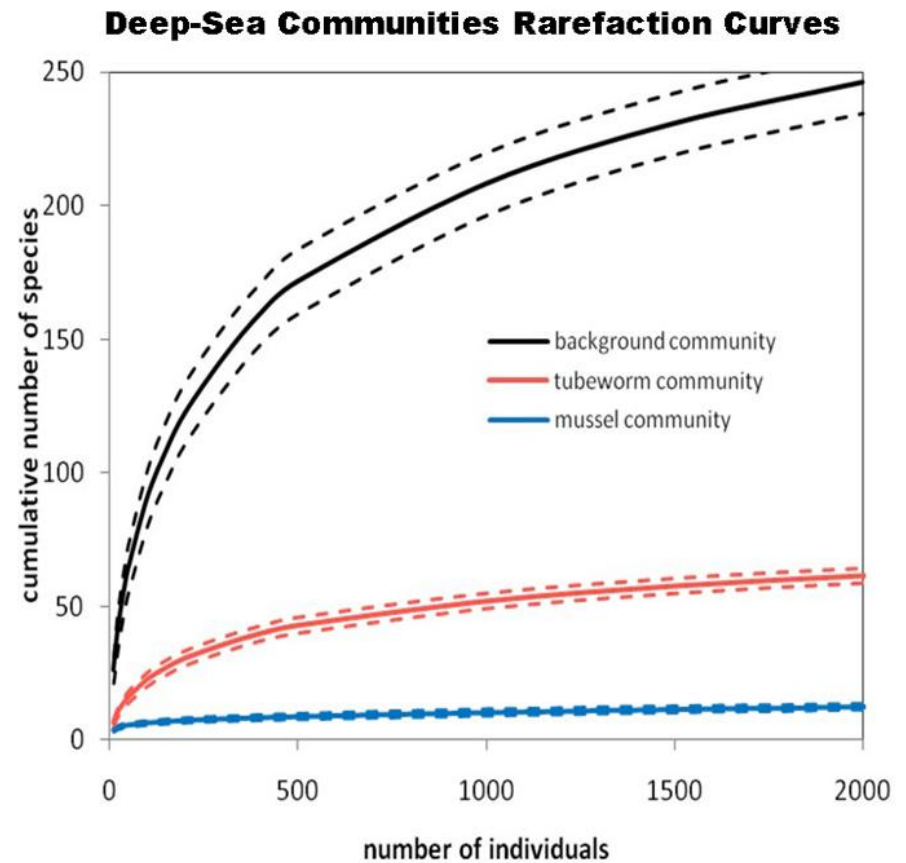
KEY POINTS

- **access to the deep sea has improved in recent decades, but understanding the ecology of the deep sea requires expensive ships and technologies**
- **the deep ocean is complex, with a number of dominant physiographic features well known and other features still to be discovered**
- **a diverse fauna inhabits the deep sea, with many species still undiscovered; this fauna varies from one region to the other and is generally adapted to food-poor conditions**

DEEP-SEA BIODIVERSITY



Day et al. 1968; Rex 1981



Cordes (FLEXEFORUM)