



Submarine Canyons as Unique Ecological Systems

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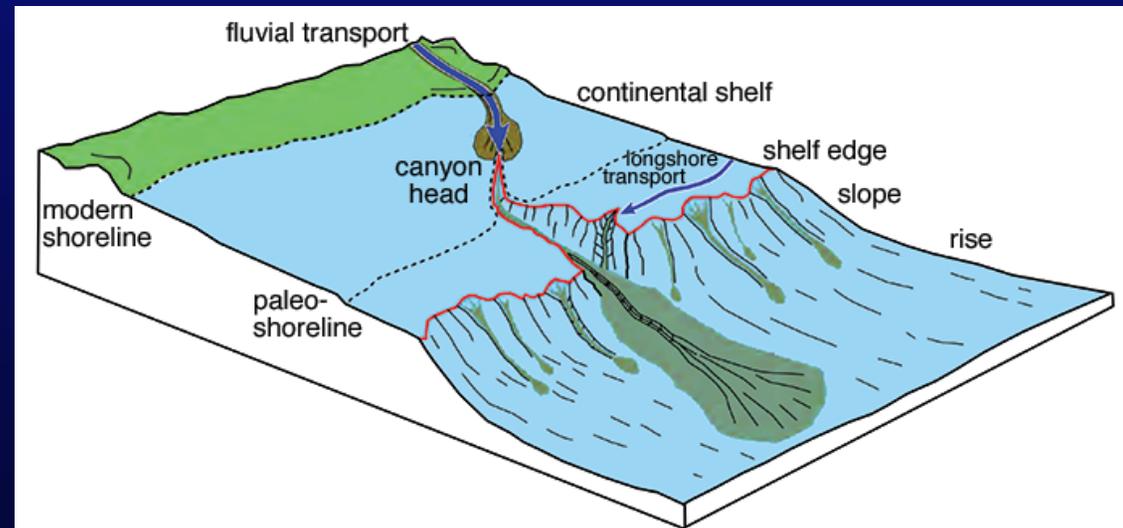
Leetown Science Center, WV

Amanda Demopoulos

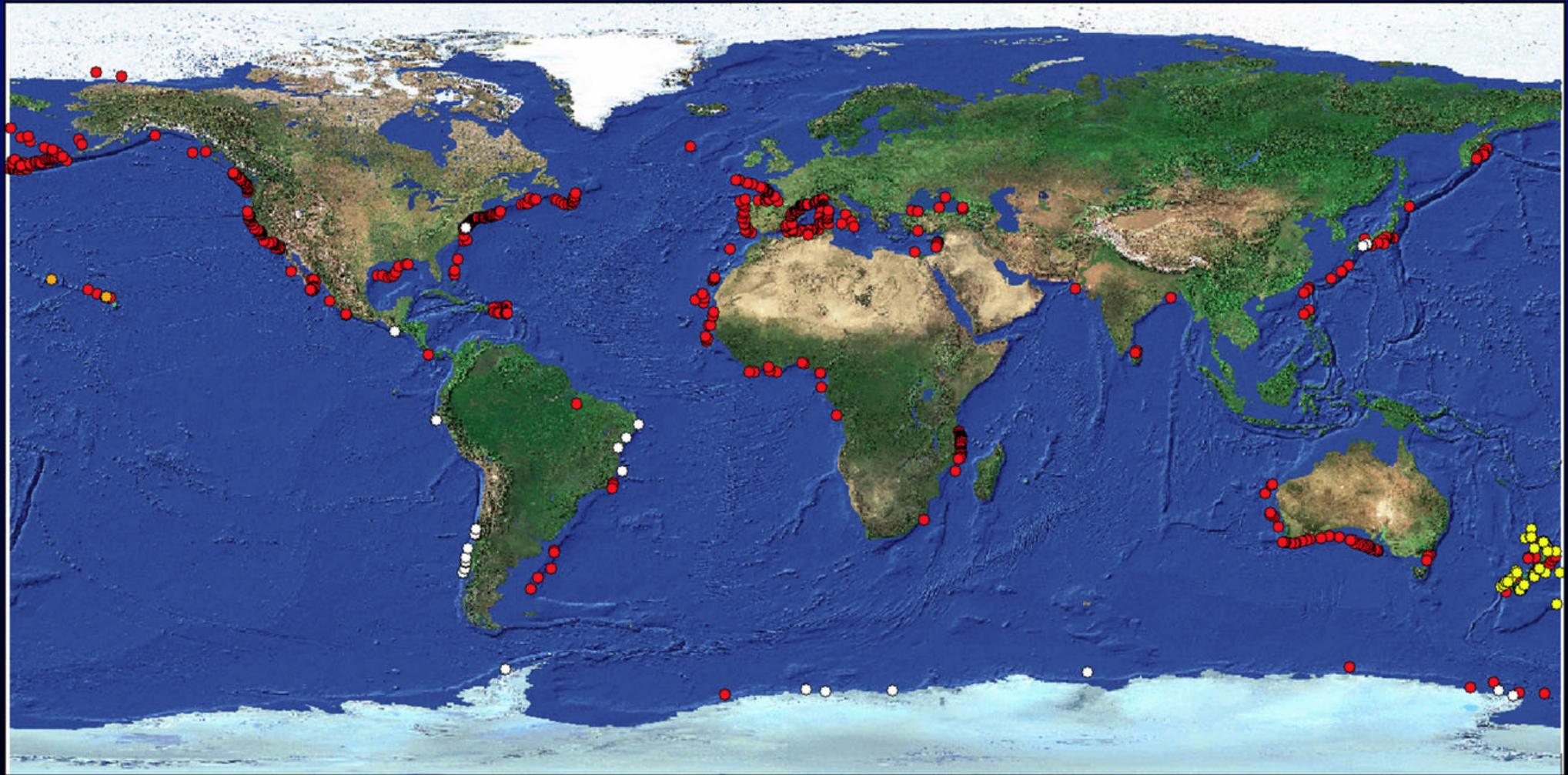
Wetland and Aquatic Research Center, FL

Submarine Canyons: Complex Environments

- Conduits of organic matter
- Link shelf to deep
- Concentrate food resources at depth
- Hydrodynamic activity
- Local upwelling
- Resuspension and deposition
- Enhanced primary and secondary productivity

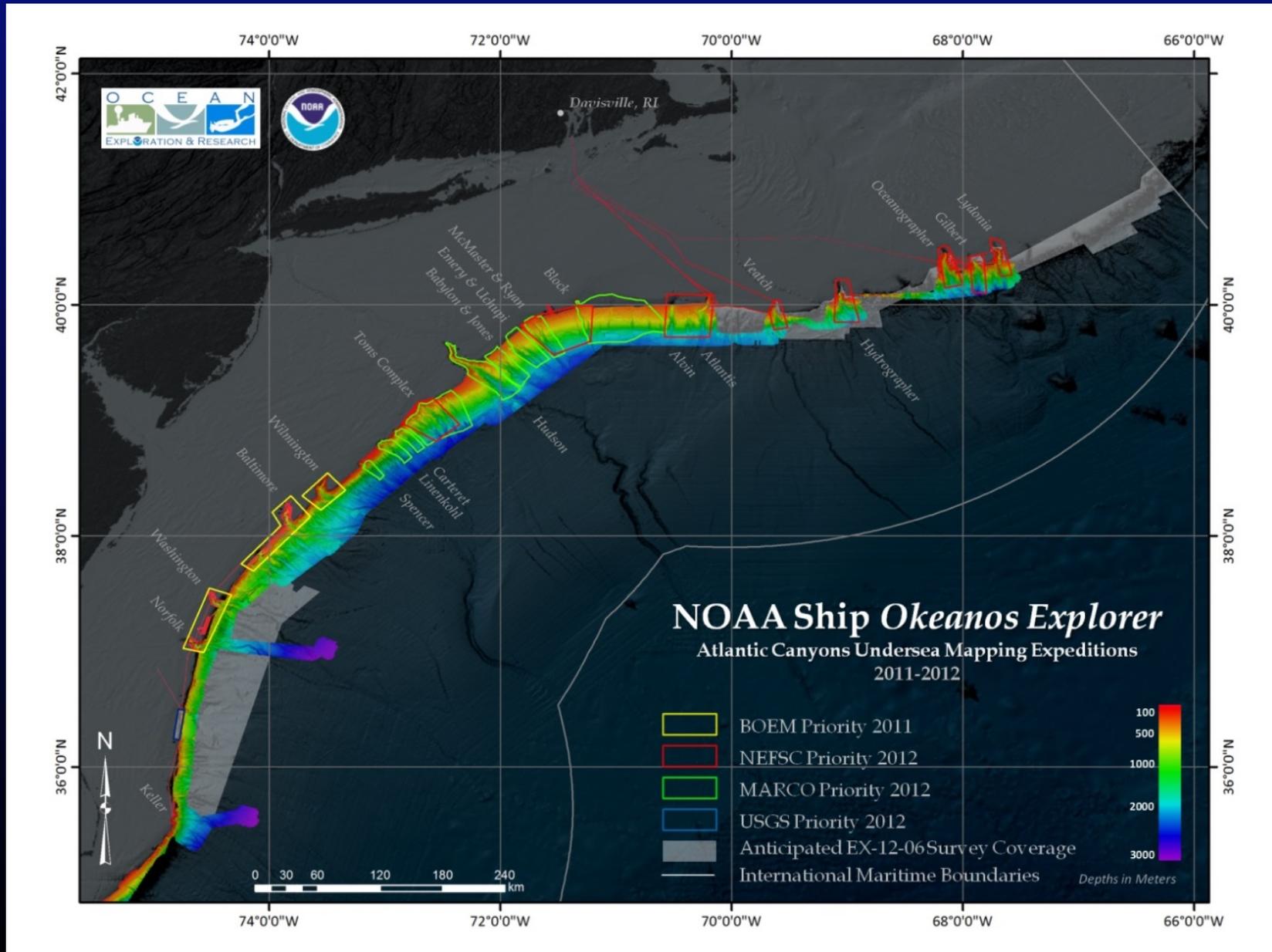


Global Distribution of Canyons



From: De Leo et al., 2010, Proc. R. Soc. 277: 2783-2792

NW Atlantic Canyons



Hudson Canyon

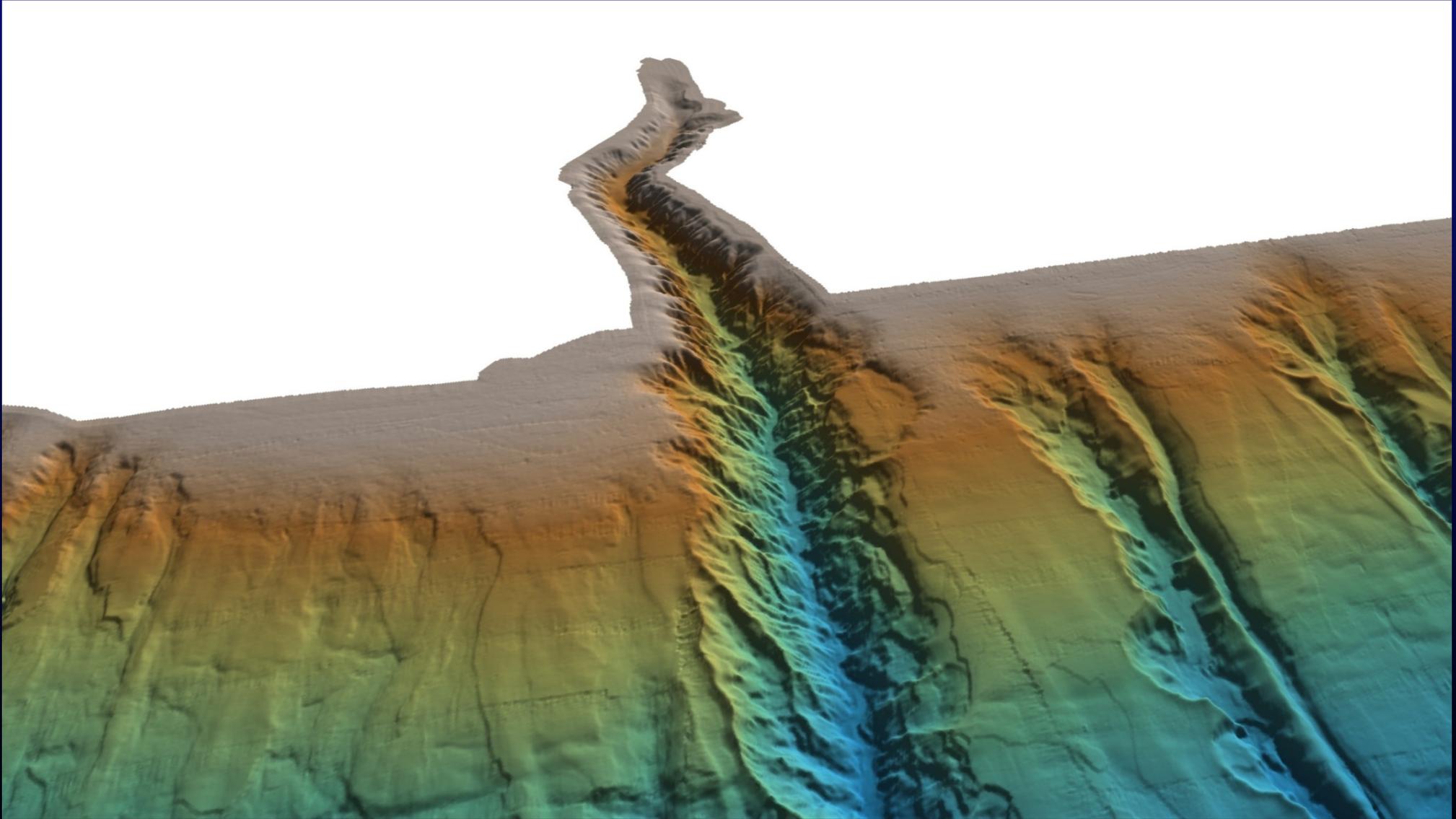
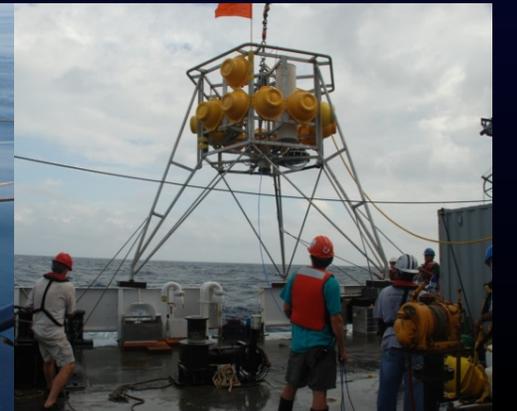
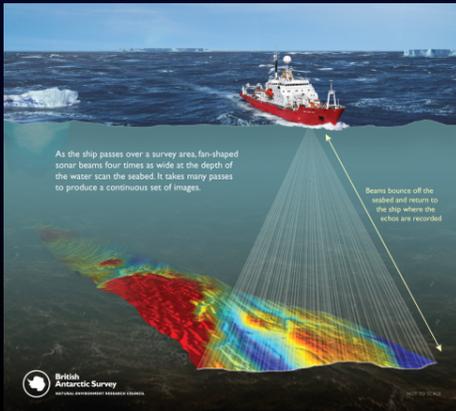


Image courtesy of Jason Chaytor, USGS.

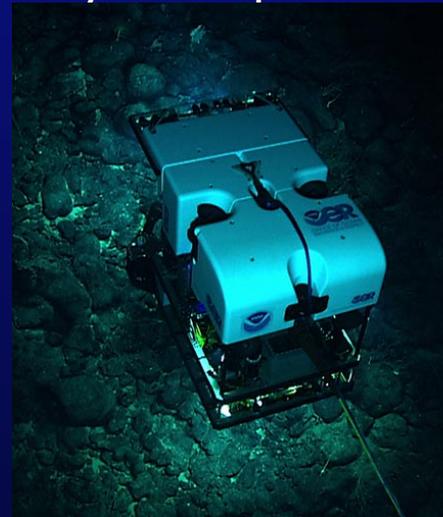
Exploring Canyons Requires Advanced Tools

- Mapping and geospatial tools
- Remotely operated vehicles (ROVs)
- Autonomously operated vehicles (AUVs)
- Long-term instrument deployments (landers/moorings)
 - Physical oceanographic characteristics
 - Biology



NW Atlantic Canyon Explorations

NOAA *Okeanos Explorer* Program, Northeast U.S. Canyons Expeditions (2011-2013)



NOAA's Northeast Regional Deep Sea Coral Initiative, 2013-2015

Mid-Atlantic Canyons Study (NOAA-OER/BOEM/USGS, 2012-2015)



Geology Influences Biology



Abundant Coral Communities



Cold-water Corals in NW Atlantic Canyons

- Numerous coral species observed
- Several species locally abundant
- Octocorals: *Paragorgia arborea*, *Primnoa resedaeformis*, *Paramuricea*, *Anthothela*
- Scleractinians: *Desmophyllum dianthus*, *Lophelia pertusa* (1st observations in mid-Atlantic, more rare than others)
- Many abundant canyon coral species have wide but disjunct geographic distributions
- Canyons channel currents, larvae may be retained
- Are populations among canyons interconnected via larval exchange?



Importance of Connectivity

Paragorgia



Primnoa



Lophelia



Desmophyllum



- Majority of corals examined not genetically differentiated at MAB canyon level (*Paragorgia arborea*, *Desmophyllum dianthus*, *Lophelia pertusa*)
- *Primnoa resedaeformis*- differentiated by canyon
- One conservation strategy may not be optimal for all ecologically significant canyon species
- Importance of highly comparable genetic data sets across taxa in order to understand patterns of connectivity and to best manage canyon ecosystems

Connectivity of Surface and Benthic Communities

- Productivity and complexity visible at surface
- Enhanced primary and secondary production supports fisheries, marine mammals, birds
- Indication of complex food webs



Diverse Food Webs



Diverse Food Webs



Complex Species Interactions

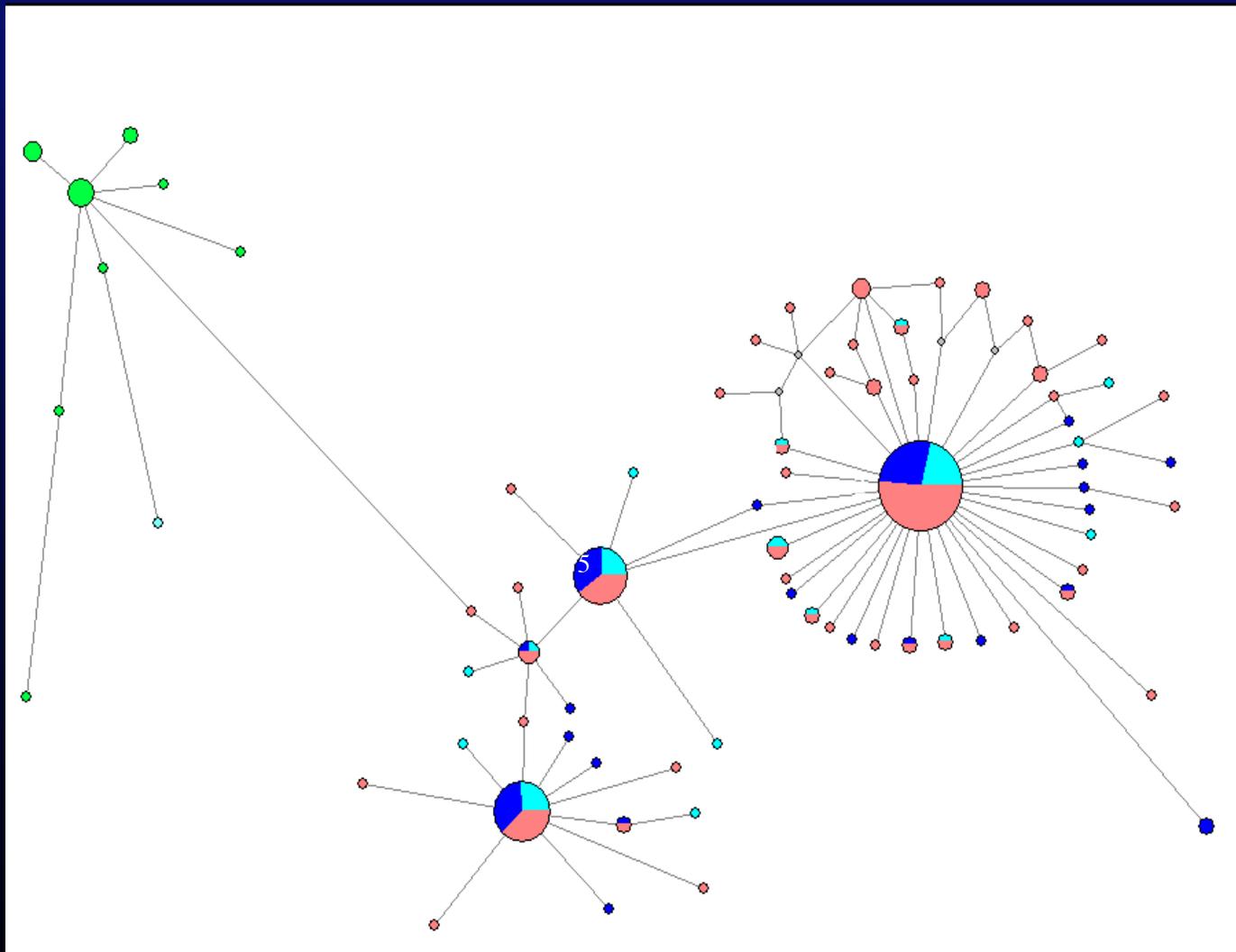


Chemosynthetic Habitats



Image courtesy of Deepwater Canyons 2013 - Pathways to the Abyss, NOAA-OER/BOEM/USGS.

“*Bathymodiolus*” *childressi* cold seep mussel mtCOI haplotype network



- Baltimore
- Norfolk
- Gulf of Mexico
- Barbados Prism

Conclusions

- Canyons support highly diverse community
 - Faunal biomass >> than surrounding seafloor
 - Closely associated fauna
- Habitat features influence biology
- Feeding areas
 - Invertebrates
 - Fishes (vertical migrators)
- Connections to shallow water
 - Majority of habitats rely on surface productivity for food
 - Cycle nutrients from shallow to deep and back
- Unique geological and biological aspects to each canyon-
extrapolate?



Future Research

- Continued use of targeted technologies
 - Bathymetric maps (research vessels/AUVs)
 - Habitat modelling/predicting prime habitat
 - Observations (ROVs)
- Video, imaging: ground-truthing geology & biology
- Sample collections for species identifications, genetics
- Genetics and genomics
- Species identification, connectivity, presence/absence
- Remote sensing- landers and moorings
- Continued partnering!



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 - USGS Environments Outer Continental Shelf

