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## UKSR ENVIRONMENTAL BASELINE PROGRAMME: Abyssal Benthic Biological Baseline Studies (ABYSSLINE)

WORKSHOP ON TAXONOMIC METHODS  
AND STANDARDIZATION OF MACROFAUNA  
IN THE CCZ  
Uijin-gun, Gyeongsangbuk-do, South Korea  
23 – 30 November, 2014

- **UKSR General Strategy for Environmental Impact Assessment**
- **ABYSSLINE Design and Research Objectives**
- **2013 Cruise (AB-01) Key Accomplishments**
- **2015 Cruise (AB-02) Plans**
- **Future Plans for Baseline Data Acquisition**

***UKSR is conducting a comprehensive programme of environmental assessment***

# UKSR Strategy for Environmental Assessment

- **Focus Initially on Benthic Biology**
  - Recognized as Key Topic of Interest
  - Very Limited Data Available
  - Other Topics of Interest are Inherently Site Specific
- **Use the Best Available Scientists**
- **Maximize Synergy with Exploration Objectives**
- **Encourage Collaboration**
- **Make Results Public as Early as Possible**



*Programme focused on Benthos, Led by Top Scientists, and Transparent*

- **Use state-of-the-art approaches consistent with ISA guidelines**
- **Objectives to Address the Following Questions:**
  - What are the baseline conditions of community structure and biodiversity, microbes to megafauna?
  - How do community structure and biodiversity vary as a function of environmental parameters?
  - What is the biological connectivity at species and population levels across the CCZ?

*ABYSSLINE is using state-of-the art methods to address key ecological questions*



# Experimental Matrix

Class	Benthic Megafauna	Benthic Macrofauna			Benthic Meiofauna (non foram)	Benthic Foraminifera <sup>2</sup>	Larvae of Benthos	Water Column and Benthic Microbes	Ecosystem Function		Demersal Ichthyofauna/ Scavengers	Notes
		Polychaetes	Crustaceans	Total Macrofauna					Multi*	Sinking Particle Flux		
Subgroup												
Institution	University of Hawaii	NHM/UNI	Senckenberg	University of Hawaii	Senckenberg	Southampton	HPU	University of Hawaii	University of Hawaii/HPU	IRIS	University of Hawaii	
Abundance/Amount		N/A										
Diversity		(Richness)	(Richness)	(Evenness & Richness)					N/A	Macrofauna		Diversity includes components of evenness and species richness.
Species Composition								Generic (Not Species)	N/A	Macrofauna		i.e. a list of species or other appropriate classification
Community Structure							N/A	(vs. Depth)	N/A	Macrofauna	N/A	By taxon and presumed functional groups (e.g., for microbes aerobic vs. anaerobic)
Population Connectivity <sup>1</sup>	(With NHM and Senck.)			N/A			N/A	N/A	N/A	N/A	(With NHM and Senck.)	morphology/DNA barcode vs. distance to establish species ranges
Relation to Nodule Abundance/Size					(Sediment + Nodules)	(Sediment + Nodules)	N/A	N/A	N/A	N/A		
Relative Abundance		N/A						N/A	N/A			
Species Range	N/A			N/A			N/A	N/A	N/A	N/A		
Taxonomy	N/A			N/A			N/A	N/A	N/A	N/A		
Sampling Tool	ROV/ Brenke Sled	Box Core/ Brenke Sled	Brenke Sled	Box Core	Multi-Core	Multi-Core/ ROV Box Core Sled	ROV Towed Plankton Net and Near-Bottom Sediment Trap	Multi-Core	Near-Bottom Sediment Trap	Sediment Respirometer	Baited Cameras and Traps	
Principal Investigator	Smith	Glover Dahlgren	Martinez	Smith	Martinez	Gooday	Vetter	Church	Vetter	Sweetman	Drazen	

\* copepods, isopods, cumaceans, tanaids

1: Studies of Population Connectivity and CCZ-Wide Gene Flow are the same thing. 2: Foraminiferan span a variety of size classes, but they are studied as a single faunal group because of the extraordinary specialized knowledge required to work with them

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# ABYSSLINE Principal Investigators



**Adrian Glover**, Natural History Museum, London UK

**Andrew Gooday**, National Oceanography Center, UK



**Thomas Dahlgren**, Uni-Research, Norway

**Andrew Sweetman**, IRIS, Norway



**Pedro Martinez Arbizu**, DZMB-Forschungsinstitut,  
Senckenberg van Meer, Germany



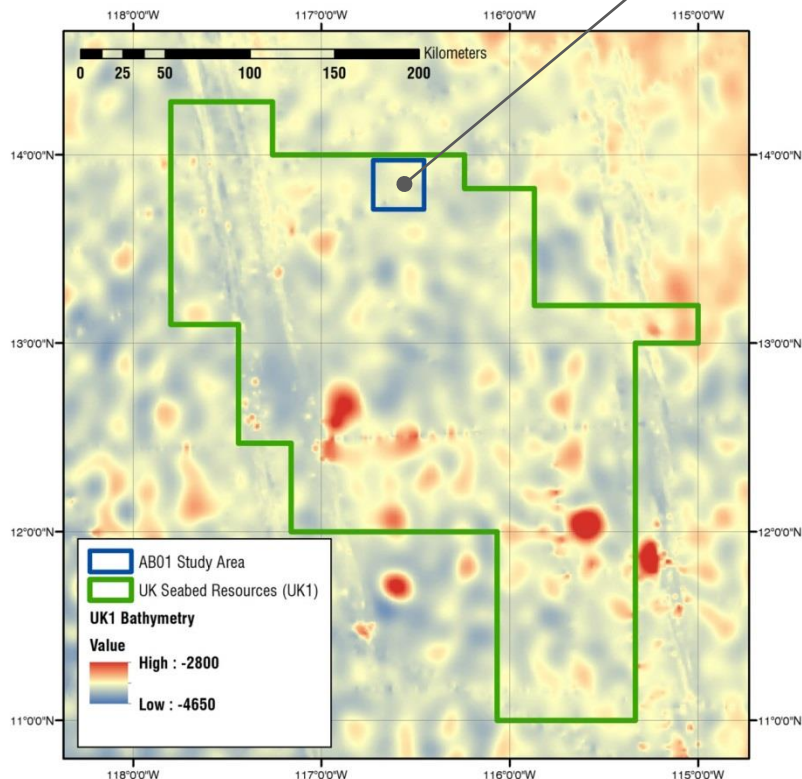
**Craig Smith, Jeff Drazen, Matt Church**,  
University of Hawai`i, USA

**Eric Vetter**, Hawai`i Pacific University, USA

*The ABYSSLINE team includes world leading researchers in deep-sea biology*

Environmental parameters mostly unconstrained, so we have adopted a stratified random design for study areas

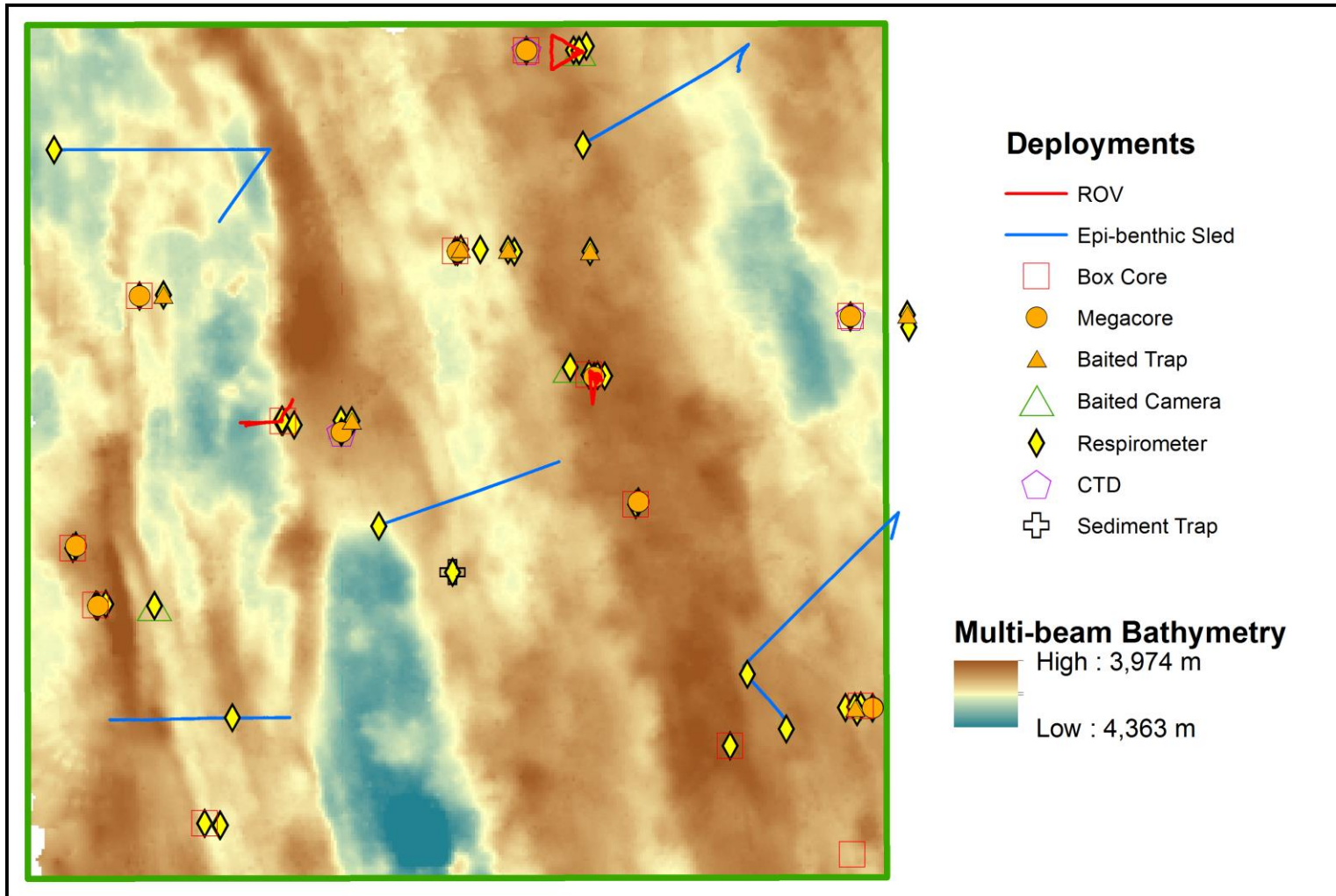
2013 AB01 Study Area



## 30 X 30 km Study Areas

- Large enough to include range of environmental parameters (e.g., variable Nodule deposits and topography)
- Small enough for intensive study during a 30-40 day cruise

# ABYSSLINE01 Deployments

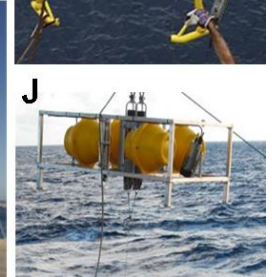
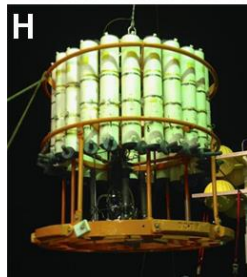
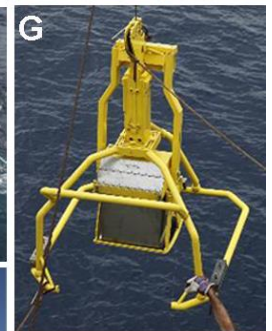
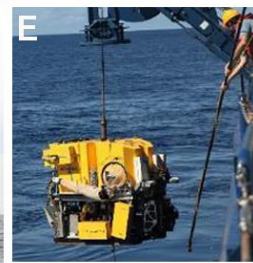
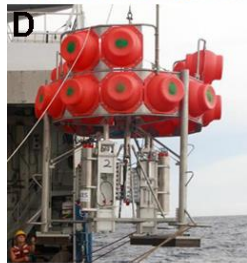
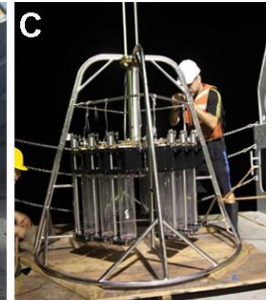
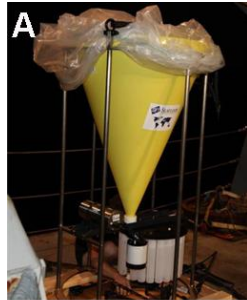


*Extensive Samples and Data were Collected at AB01*



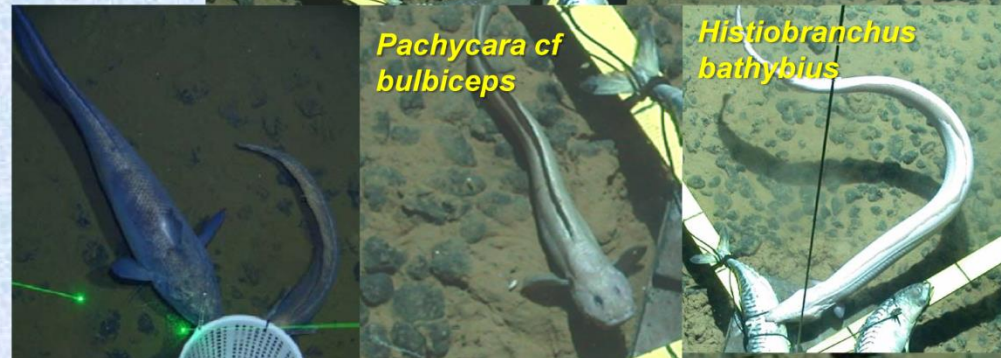
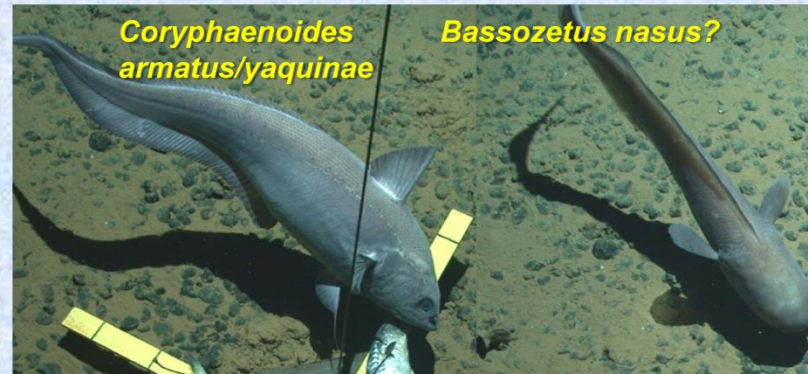
# ABYSSLINE01 Summary of Collections

- Deployed sediment trap **(A)**
- 5 epi-benthic sled runs **(B)**
- 10 megacores **(C)**
- 3 respirometer landers **(D)**
- 4.5 km HD ROV survey **(E)**
- 4 baited traps **(F)**
- 12 box cores **(G)**
- 3 CTDs over entire water column **(H)**
- R/V Melville **(I)**
- 1 baited camera **(J)**



## Trapping Camera species list

- One baited camera deployment and one bait experiment with the ROV
- 5 species of fishes, 2 shrimps, and many small amphipods

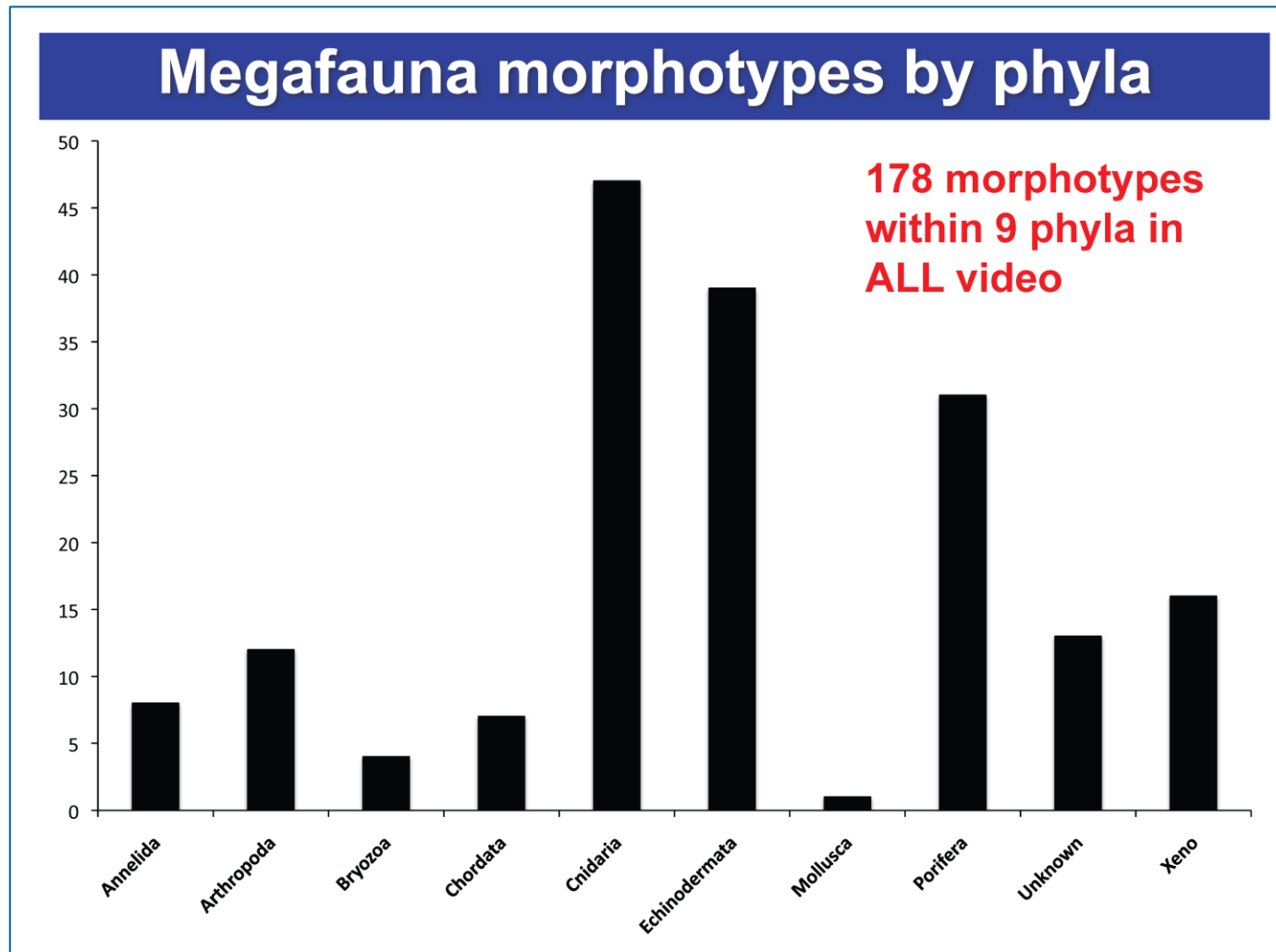




## Trapping summary

- 6 deployments
- ~1000 small amphipods
- 5 *Hymenopeneus nereus* (2 more with Pedro may also be)
- 2 *Eurythenes* spp.
- 3 *Coryphaenoides armatus*
- 9 *C. yaquinae*
- 2 *Pachycara cf bulbiceps*

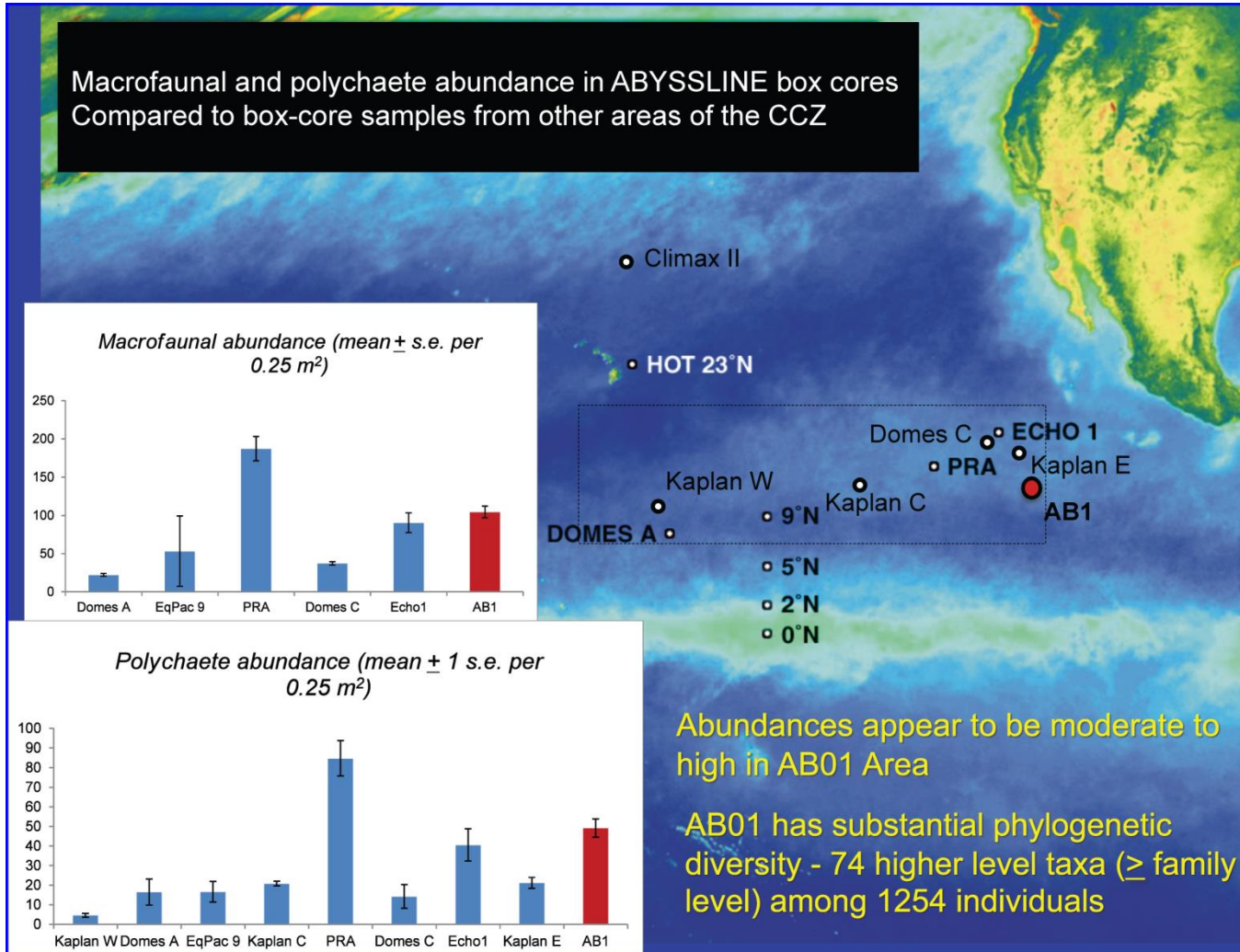




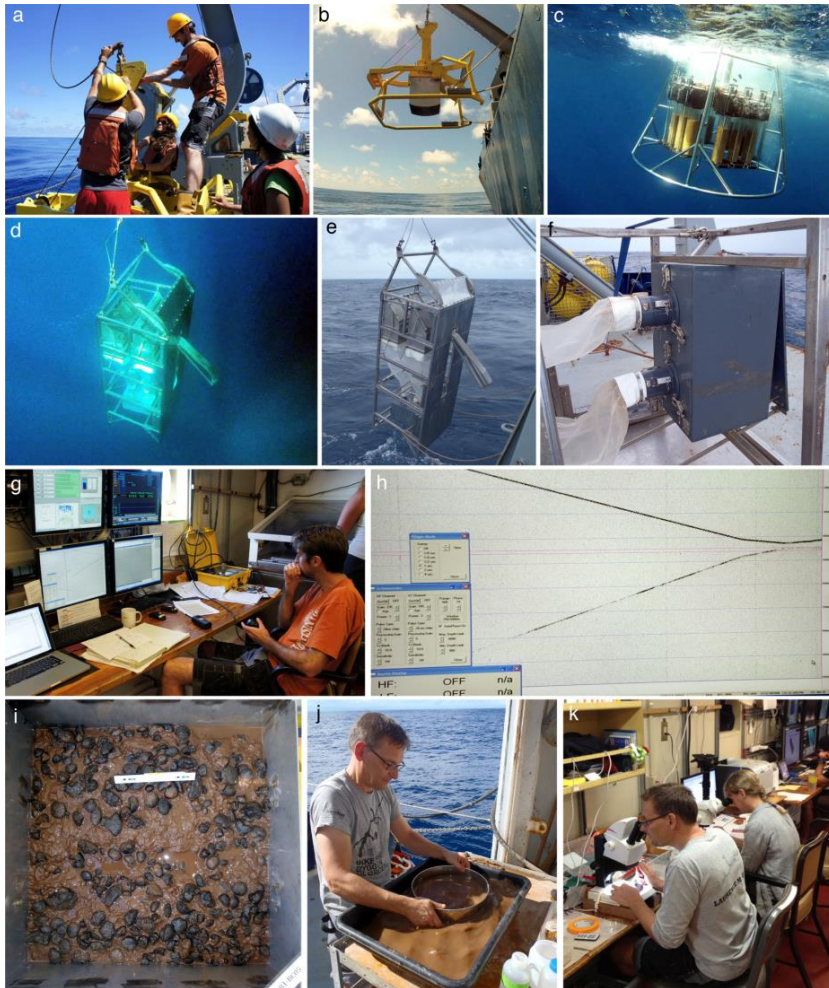
*Megafauna data and specimens very sparse in AB01 due to ROV limitations*



# Macrofauna from Box Cores



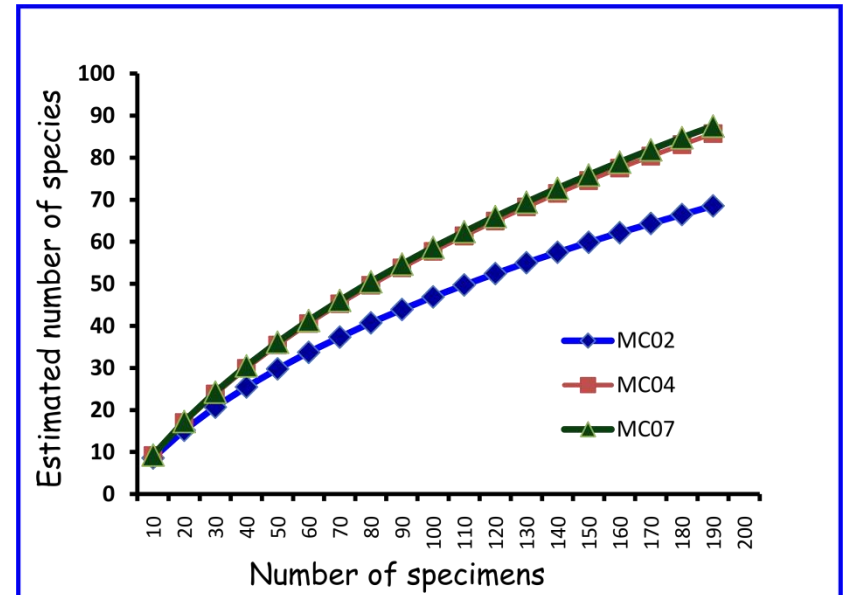
**Macrofauna abundance in AB01 moderate to high, with high diversity**



- Taxonomic and Genetic Characterization of Macrofauna and Megafauna
- Opportunistic sampling from all tools
- First ever live sorting of abyssal samples
- 485 taken with high resolution photo-micrographs and material for high-quality DNA and morphology

***Combined Morphological & DNA Characterization Lead to Unprecedented Accuracy for Macrofauna and Megafauna Identification***

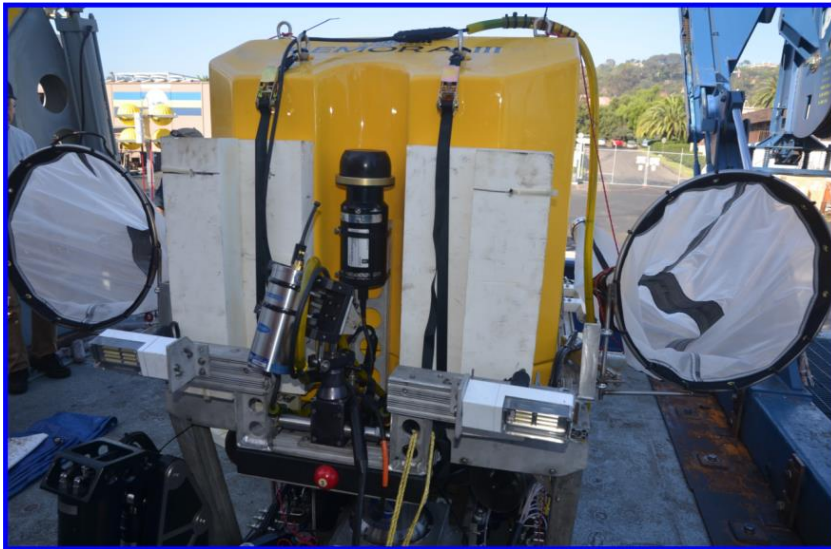
- On sediment and nodules; key organisms across all size classes in the deep sea
- AB01 hosts dozens of species; many more species likely with further research
- Xenophyophores; important epifauna on nodules and very common at AB01



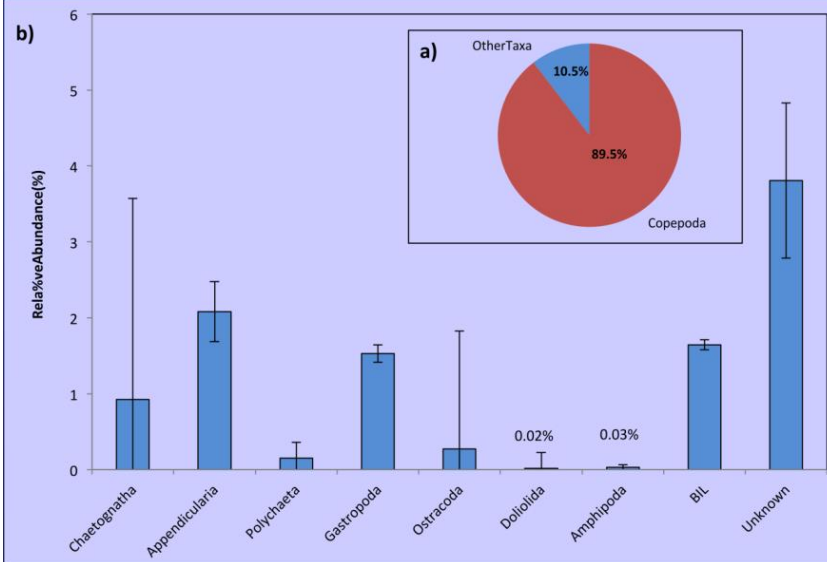
*Foraminifera are highly diverse and cross all size classes in the CCZ*



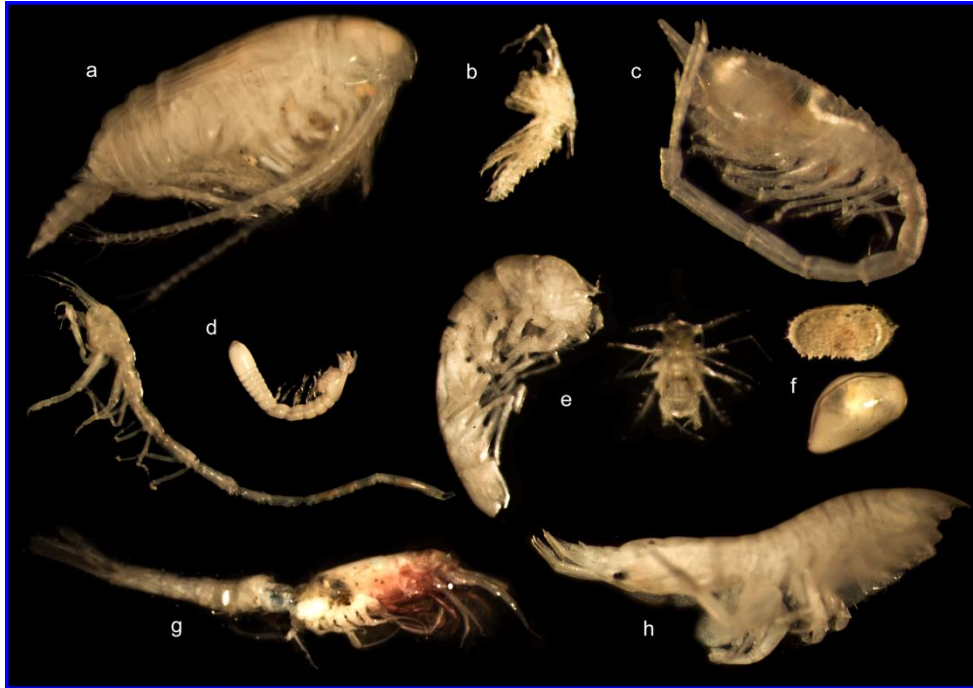
# Benthic Plankton Collections



- Benthic plankton collected with ROV using specialized nets
- Collections limited and qualitative due to ROV constraints
- Almost 90% of collections were copepods







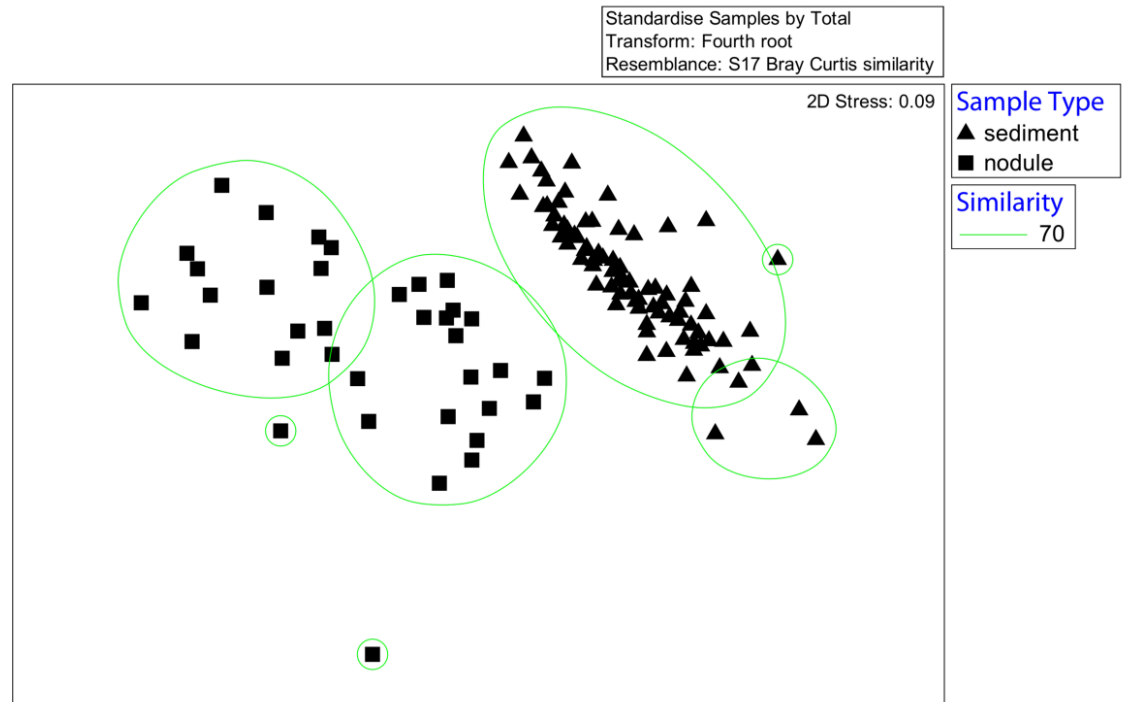
a,b: Copepods  
c: Cumaceans  
d: Tanaids  
e: Isopods  
f: Ostracods  
g: Decapods  
h: Amphipods

- DNA from 1,263 individuals
- More than half represented by one specimen
- Some species widespread, others new to science

- Distinct populations on different substrates and with depth into sediments
- Genetic sequences indicate ~1,000 distinct species of microbes
- Anticipate new insights into metabolic processes occurring in deep seabed

21

## Sediment and nodule populations are distinct



## Lander Experiments

Activity measured in Lander chambers



Division of Biomass in Surface sediment



■ Bacteria ■ Foraminifera ■ Metazoans

> Strong dominance of bacteria

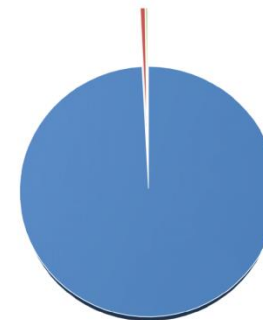
89 % of total very low biomass of about 200 mgC.-2

> Look at the uptake of tracer diatom:

> Also key role of bacteria!

> Clearly a bacteria dominated sediment system, conform the low input of organic matter?

Division of Diatom Uptake in Surface sediment



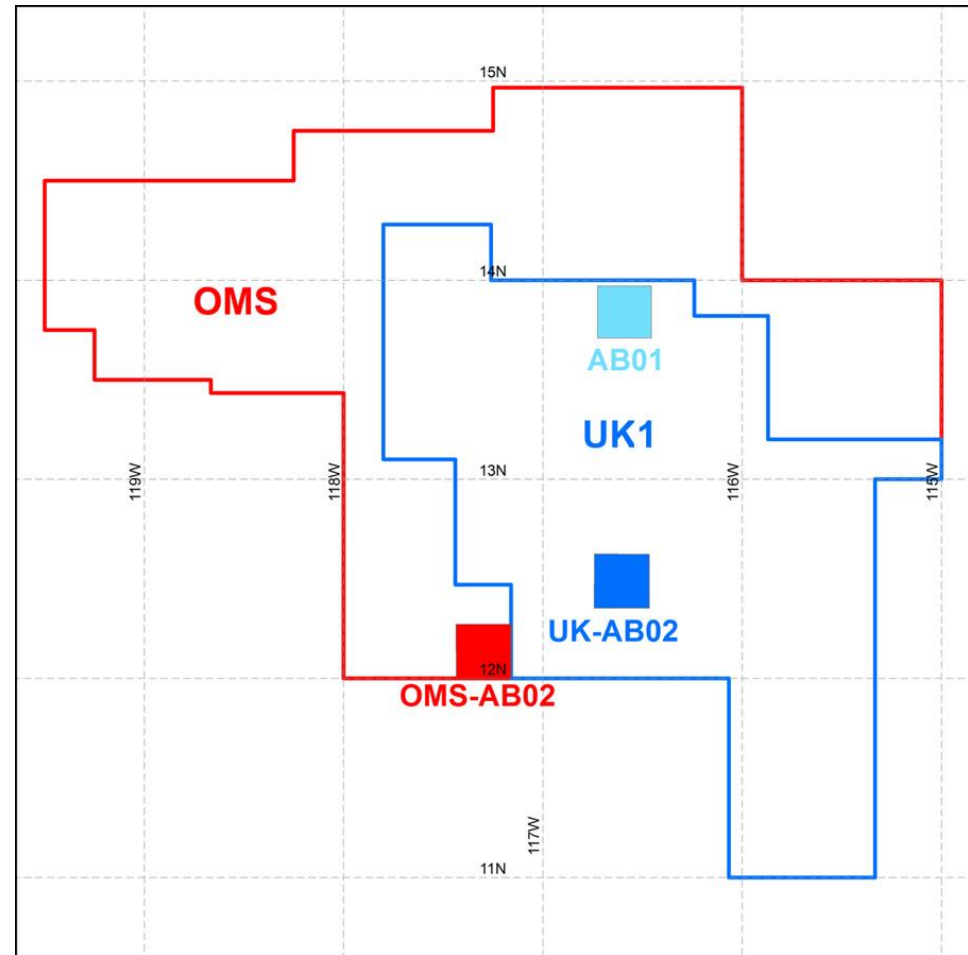
■ Bacteria ■ Foraminifera ■ Metazoans

- Overall very successful in obtaining a wide variety of biological information from the UKSR Contract area
- Extensive collection of specimens tied with high quality taxonomic and genetic characterization will help answer key questions about community structure and connectivity
- UKSR plans to continue same scientific framework design going forward



# Plans for ABYSSLINE02 in UKSR and OMS Area

- UKSR collaborating with Ocean Minerals of Singapore to hold joint cruise in 2015
  - Assumes OMS contract with ISA signed prior to cruise
  - Includes both ABYSSLINE and National University of Singapore (NUS) scientists
- Visit one 30 x 30 km strata each in UK1 and OMS Claim Areas
  - Follow same AB01 protocols
  - Expect to accomplish twice as much science as AB01 cruise.





**UK Seabed Resources**