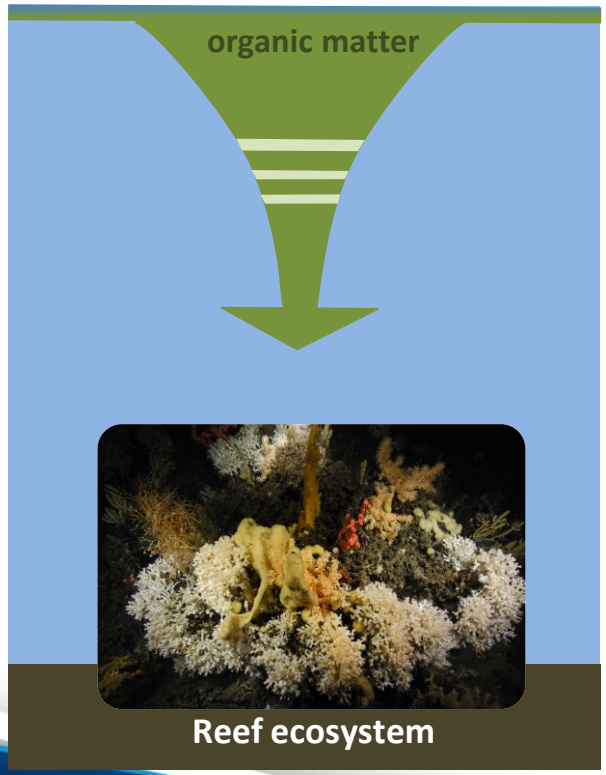
Workpackage 2 – Functional Ecosystems

Dick van Oevelen (NIOZ), George Wolff (ULiv), Ronnie Glud (SDU), Gerard Duineveld (NIOZ), Karline Soetaert (NIOZ), Christian Mohn (Aarhus), Marina Carreiro-Silva (IMAR-UAz), Cova Orejas (IEO), Sebastian Hennige (UEDIN)

Rationale:

Adaptive ecosystem-based management approaches require an understanding of ecosystem function, distribution and connections and how these may be altered by changes in food supply, climate and resource exploitation.



Rationale:

Adaptive ecosystem-based management approaches require an understanding of ecosystem function, distribution and connections and how these may be altered by changes in food supply, climate and resource exploitation.

Environmental conditions and external factors from field observations and model predictions

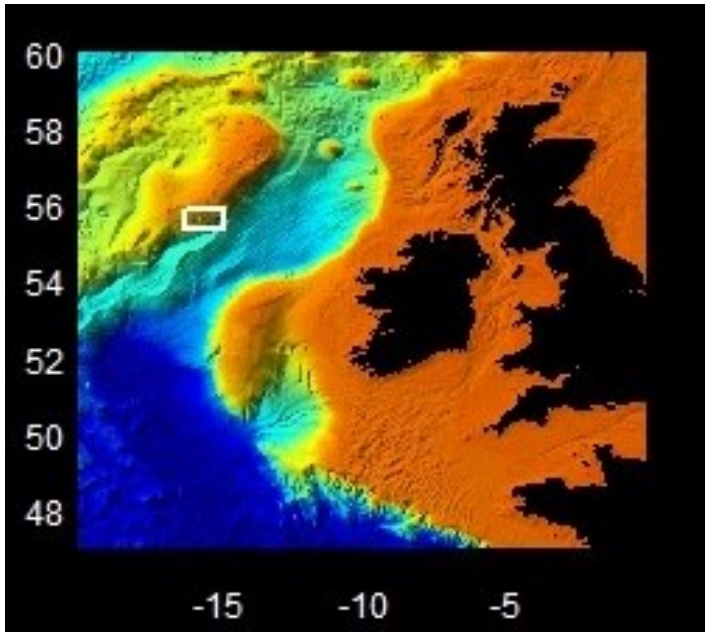
Response from physiological models based on experiments

WP2 objective:

Develop a novel predictive modelling tool that integrates external forcing and ecosystem functioning at management relevant spatial scales

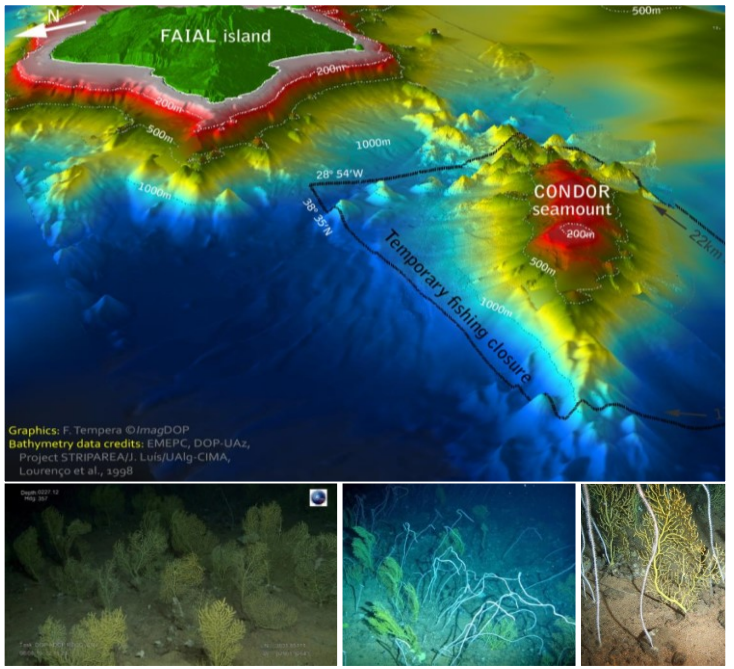
atlas

Rockall Bank



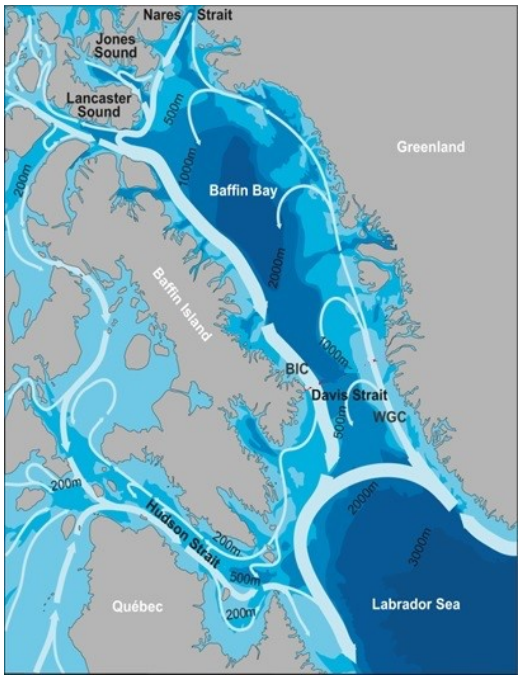
- Large coral mounds
- 600 m deep
- High data availability
- Existing models

Condor Seamount



- Coral gardens
- 200 m deep
- High data availability
- Closed for fishing

Davis Strait



- Sponge grounds
- Background data
- Cruise opportunities

Task 2.1 Identify hydrodynamic controls and organic matter supply - NIOZ (M1-M36): Hydrodynamic models will be developed for each Case Study using ROMS (Regional Ocean Model System) based on seafloor topography and basin-scale boundary conditions of AMOC and N Atlantic gyres (WP1). Hydrodynamics and OM transport will be validated with ADCP deployments.

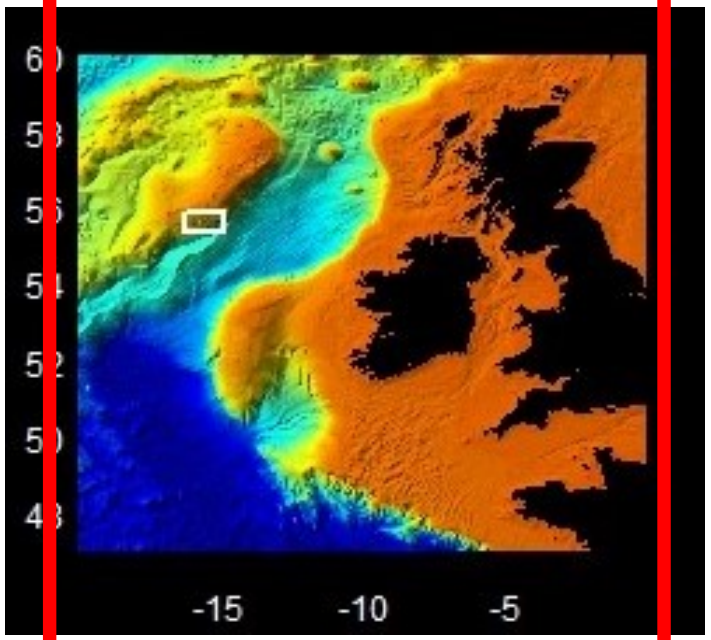
Task 2.2 OM characterisation and mineralisation - ULIV (M1-M38): Fauna and near-seafloor OM characterised and biomarker analyses performed to determine phytodetritus/zooplankton OM contributions. Total community OM mineralisation will be measured using deployments of the EC system to derive ecosystem-scale oxygen fluxes.

Task 2.3 Experimental physiology - UAZO (M1-M36): Assumed relationship between fatty acid composition of food and faunal tissues will be validated feeding with isotopically labelled organic matter (^{13}C and ^{15}N). Assumed differences in food uptake between active (sponge) and passive (coral) filter feeders will be validated using isotopically labelled food. Interactive effects of OM supply and ocean acidification on organism physiology will then be quantified.

Task 2.4 Development of integrative models - NIOZ (M3-M40): Tasks 2.1-2.3 outputs will be integrated into new coupled hydrodynamic-biogeochemical-physiological models that predict near-bed OM, biogeochemical impacts and biomass of sensitive marine ecosystems at regional management scales.

atlas

Rockall Bank



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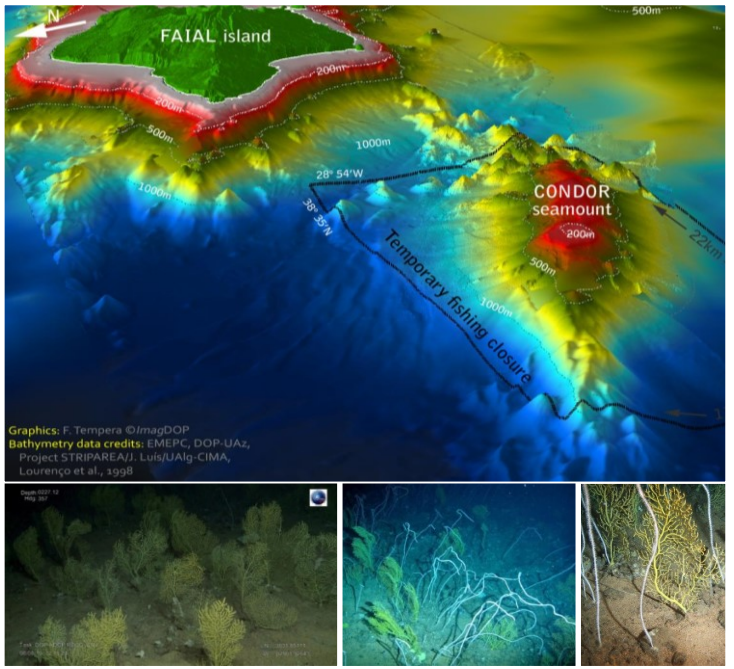

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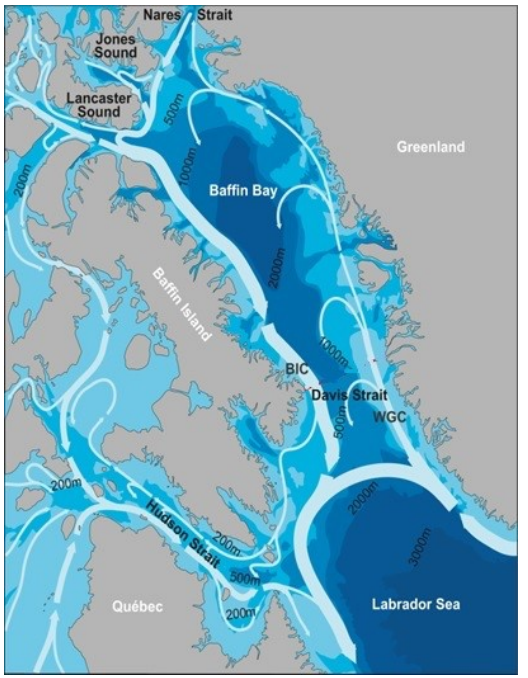

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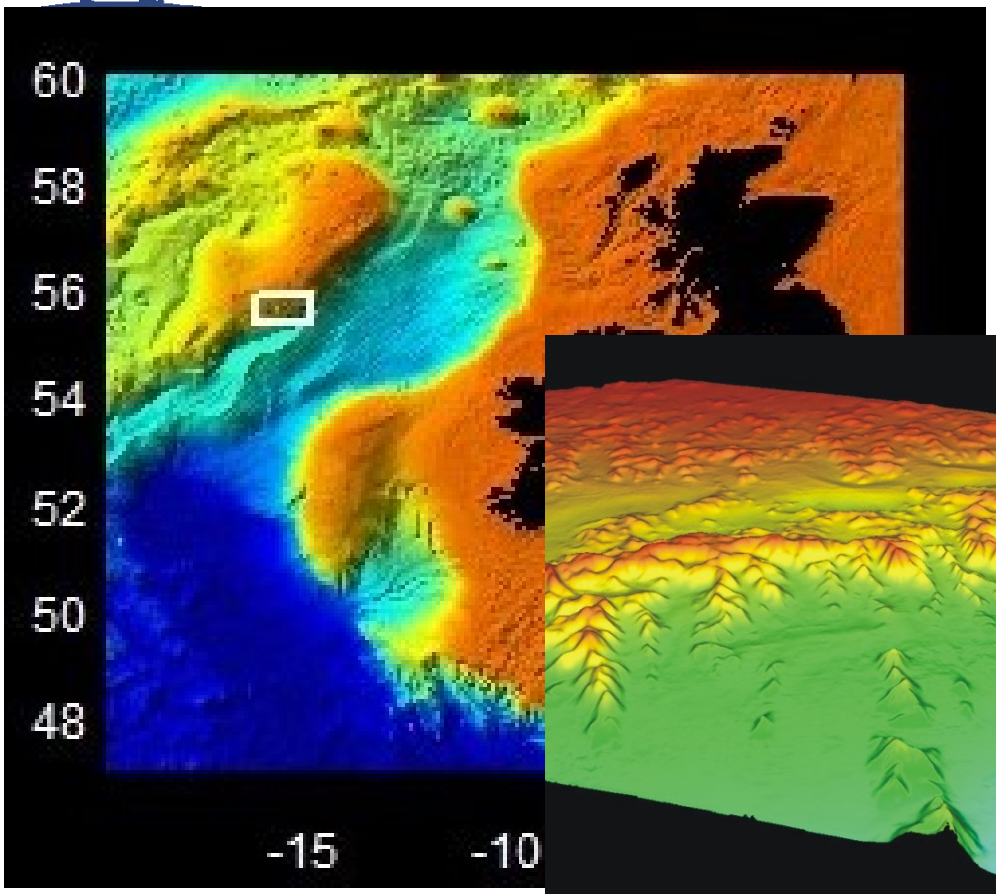
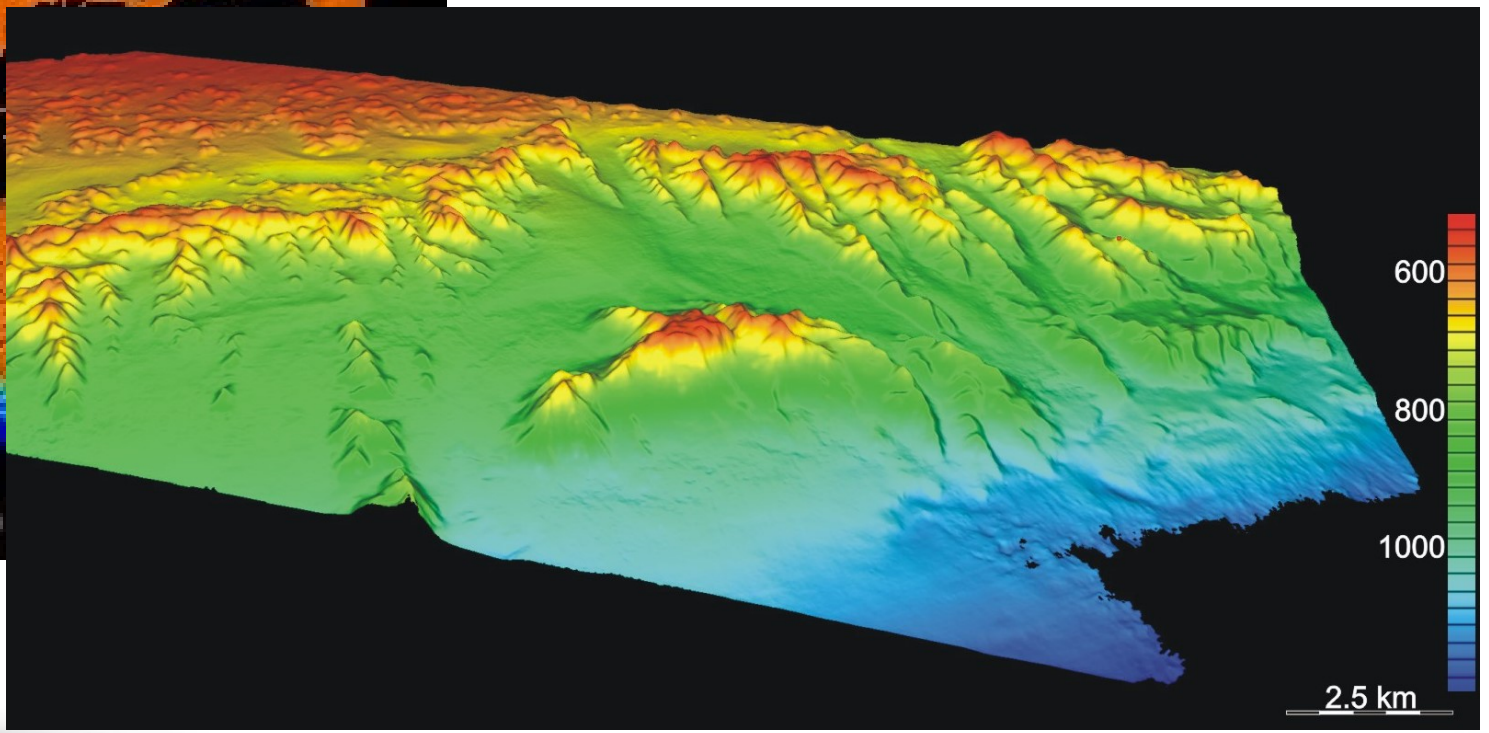
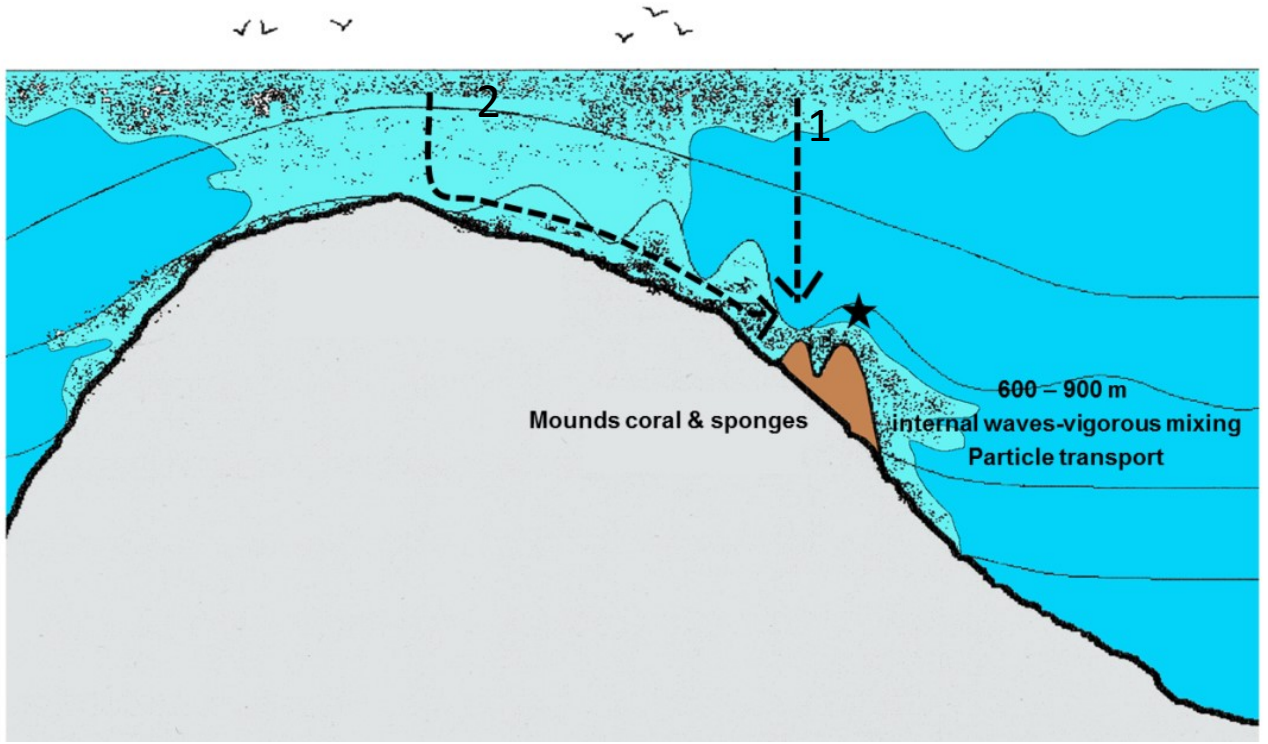




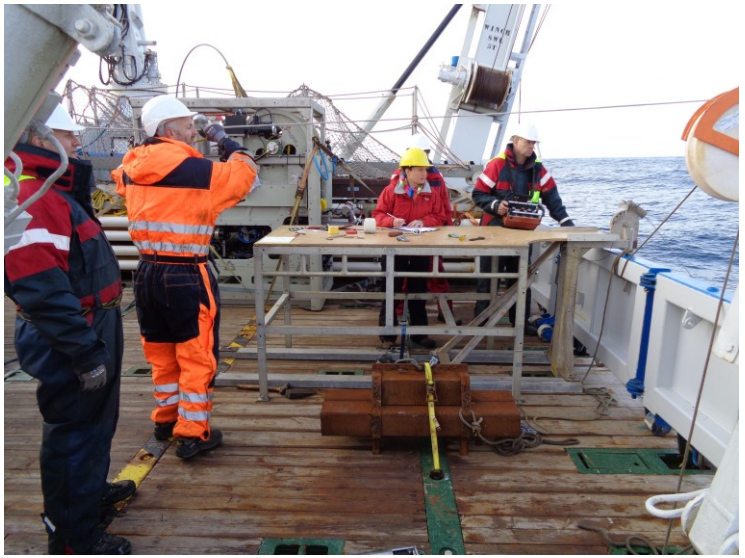


<u>Two hypotheses for food supply at Rockall bank</u>:

1. Episodic downwelling of surface-derived organic matter

2. Production on shallow Rockall Bank and subsequent cross-slope transport

RV *Pelagia* cruise 2017



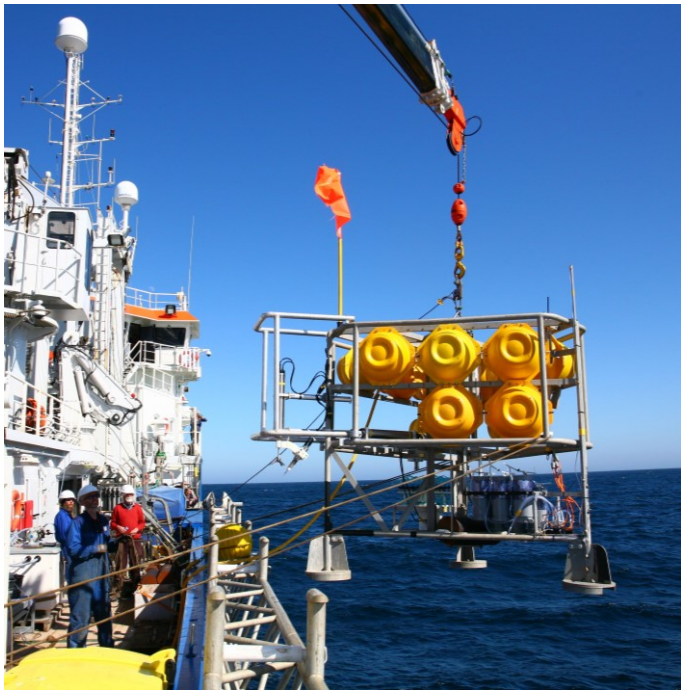
1-year mooring deployment on bank and coral mound (sediment trap, ADCPs, fluorescence sensor)

Thermistor string mooring at Haas Mound

atlas

RV *Pelagia* cruise 2017

In situ pumps for OM

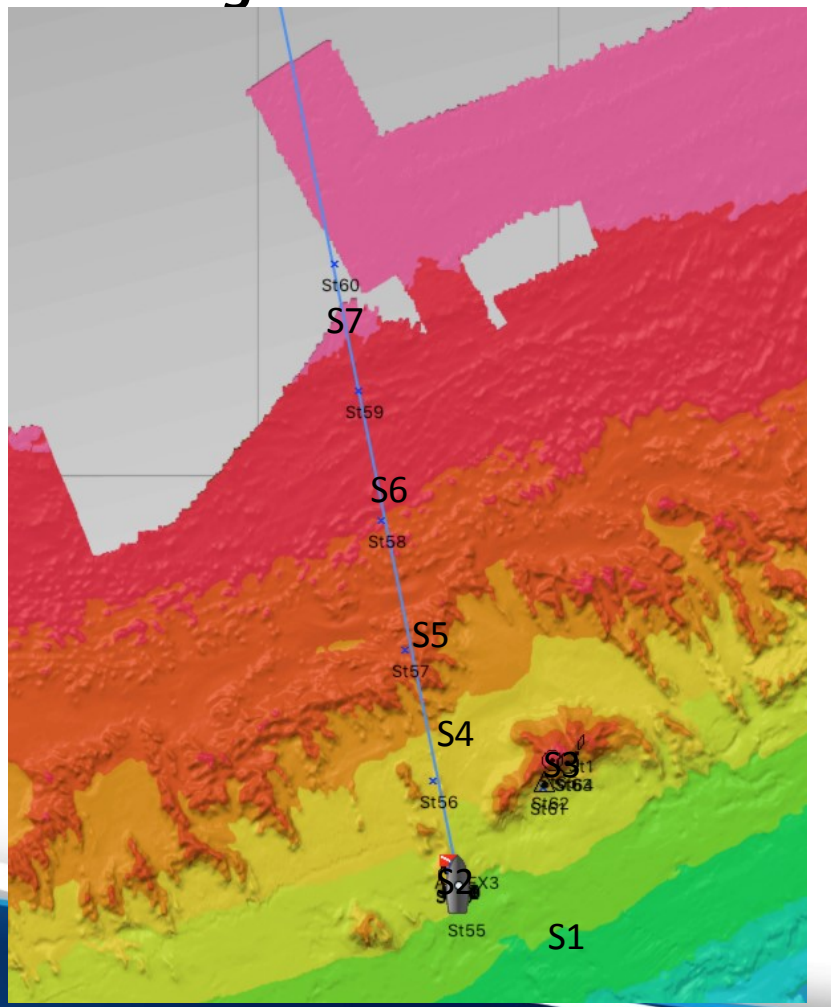


Lander deployments for particulates and O_2 flux

On-board oxygen consumption and feeding studies

Three WP2 presentations showing preliminary results

RV *Pelagia* cruise 2018

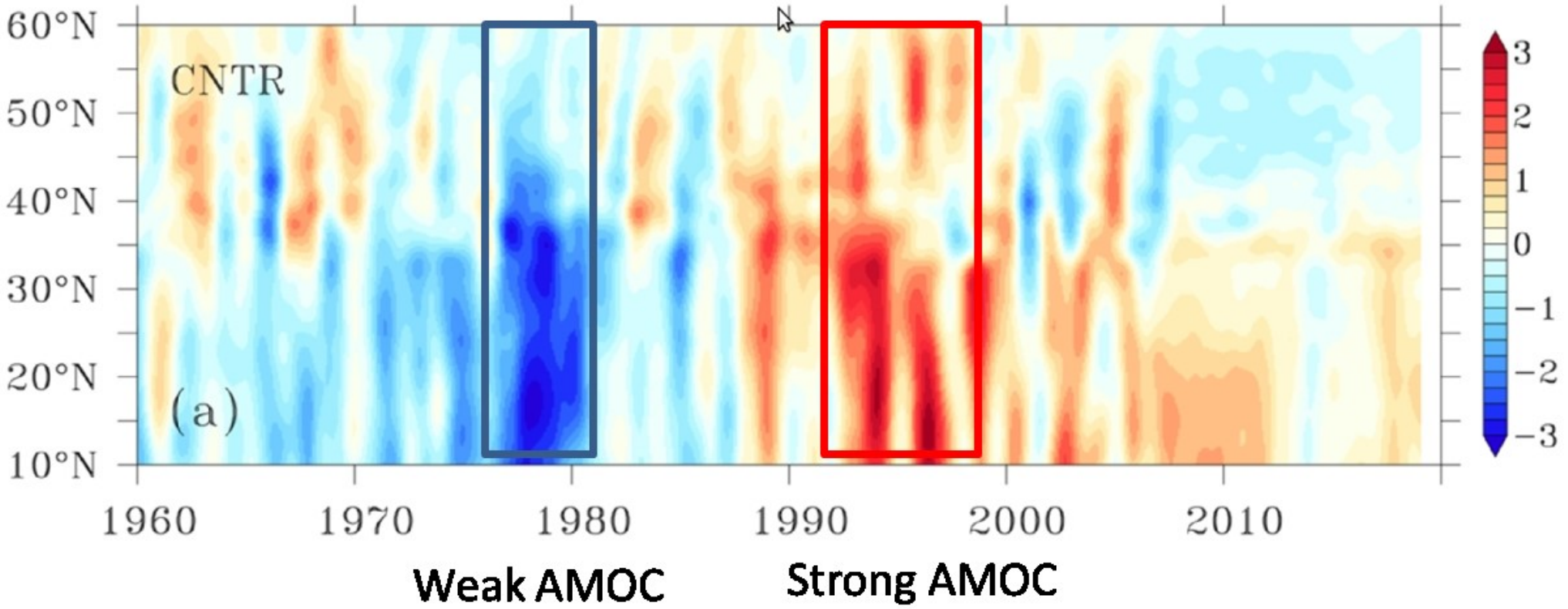


Retrieval of long-term moorings

Transect with 7 stations (diurnal tidal cycle) to monitor:

1. Surface currents with the ship-ADCP
2. CTD yoyo's
3. Water samples at 5 depths for everything between inorganic nutrients and meso-zooplankton

VIKING20 North Atlantic Basin-Wide AMOC anomalies



WP2 presentation by Christian Mohn

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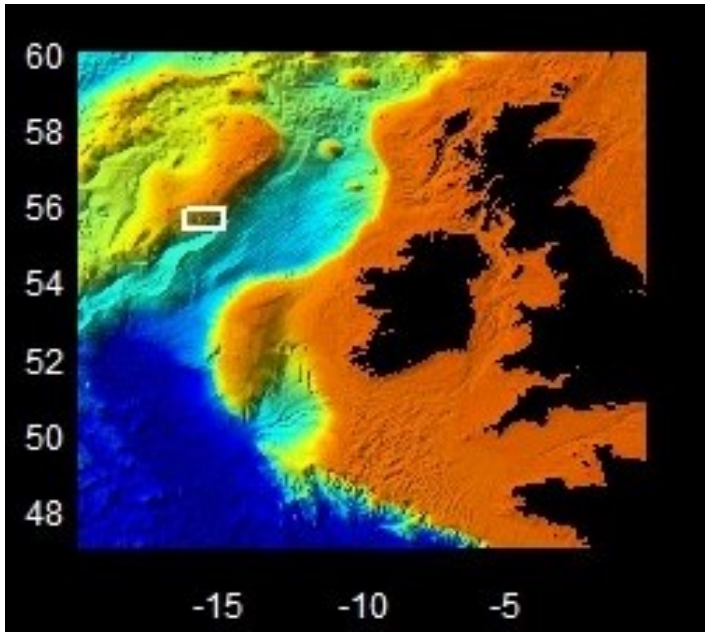
Rockall Bank



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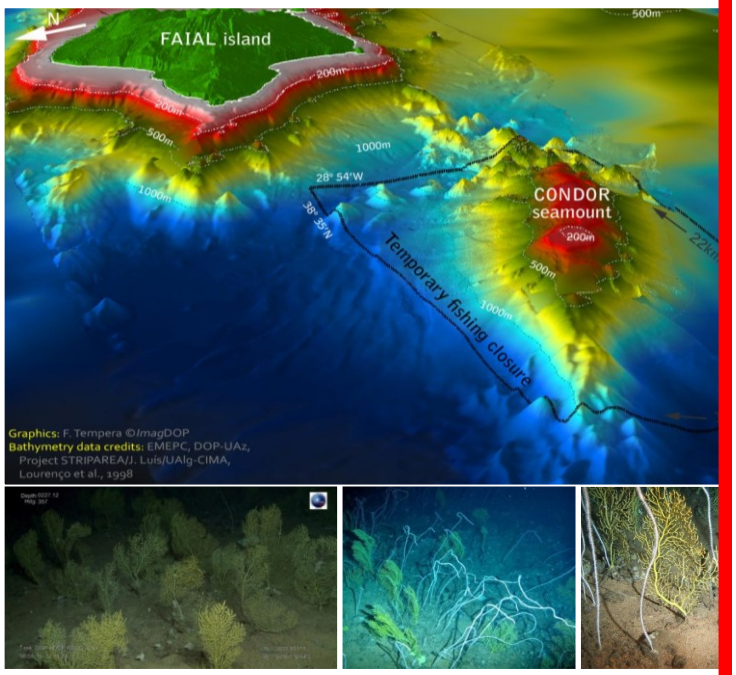
Condor Seamount



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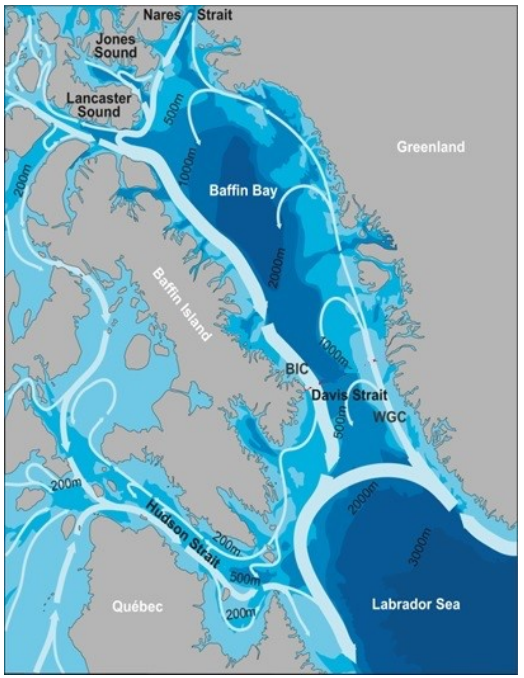

- Sponge grounds
- Background data
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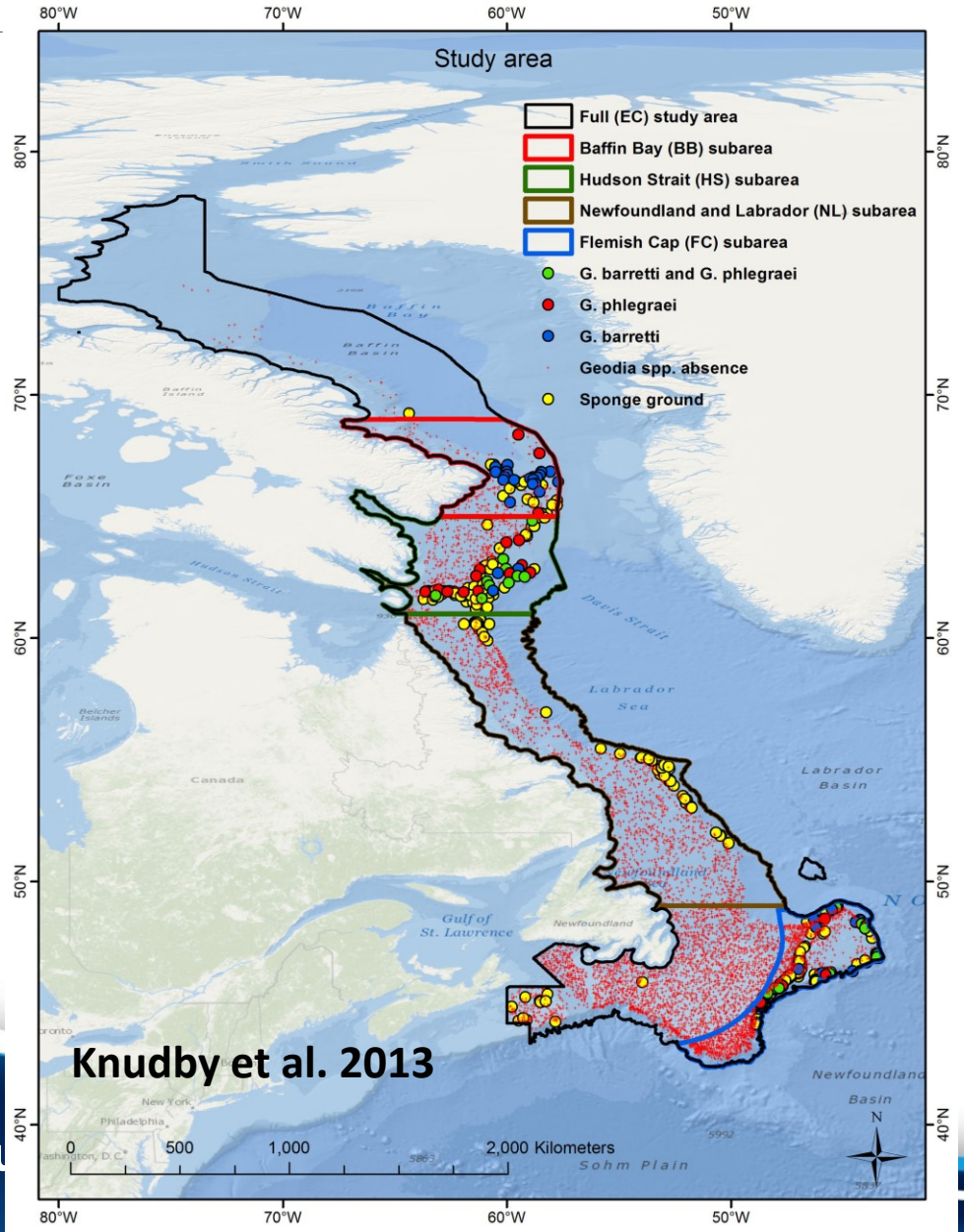
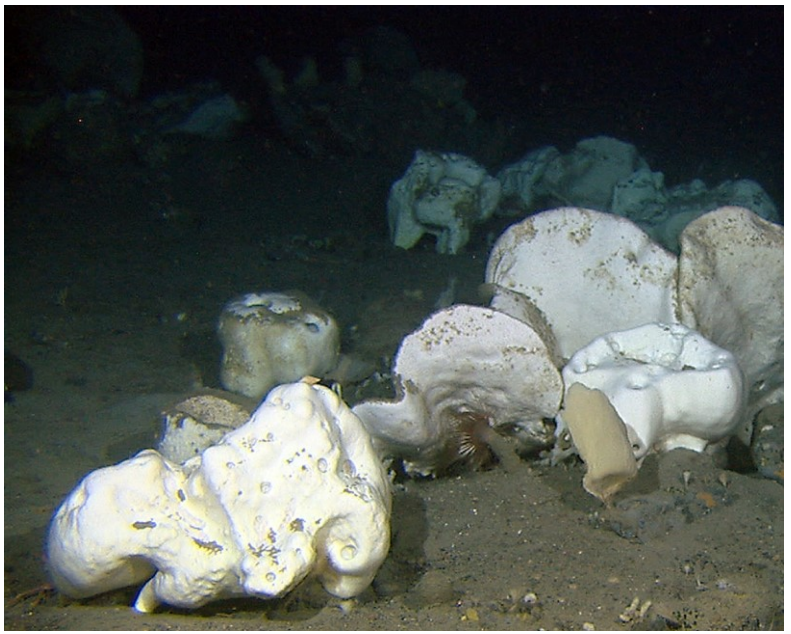


Knudby et al. 2013



ATLAS Participation in the RV *Amundsen* cruise 2018:

- Collaborative effort between DFO (Canada), ArcticNet (Canada), Steve Ross (US),BGS (UK), UEDIN and NIOZ
- Two landers (high- vs low-sponge cover) for 1 year (CTD, oxygen, sediment trap, long-range ADCP, ADV)
- CTD + NISKIN transects across slope
- Seafloor imaging with ROV to confirm sponge locations and faunal sampling
- Team up with ArcticNet sampling for data sharing

WP2 break out session today

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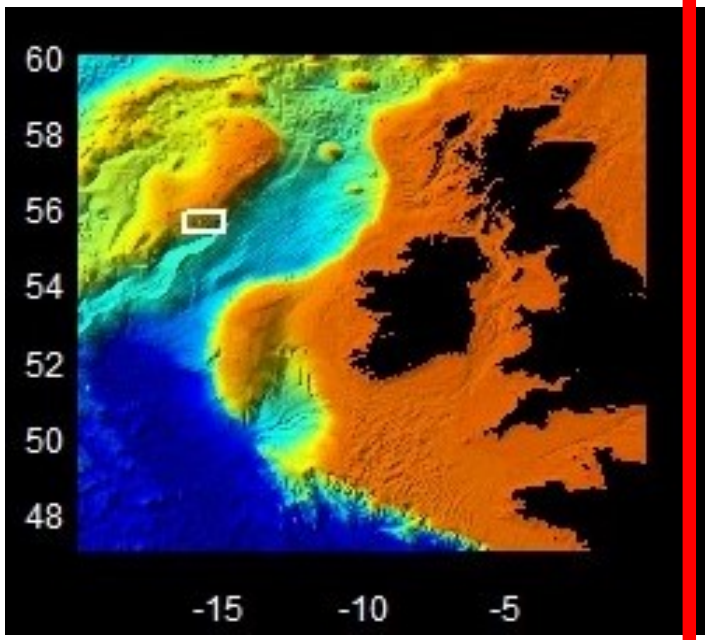
Rockall Bank



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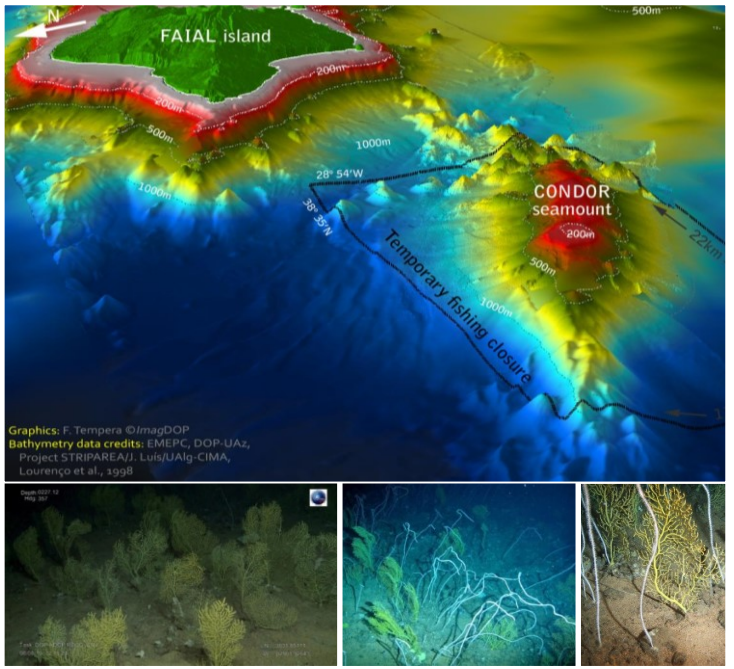

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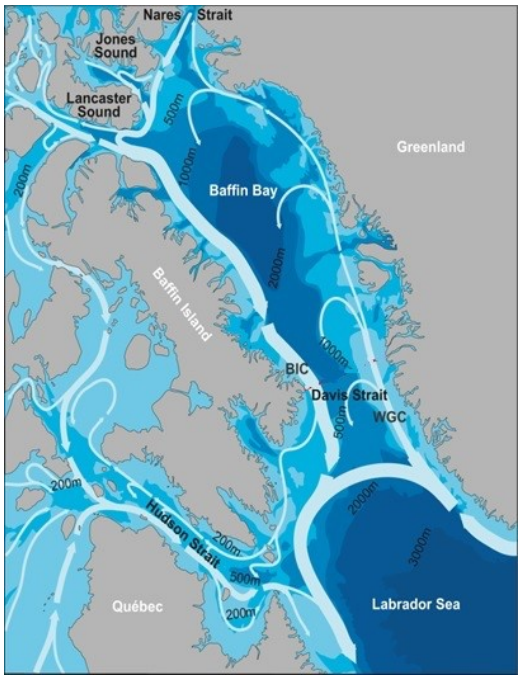
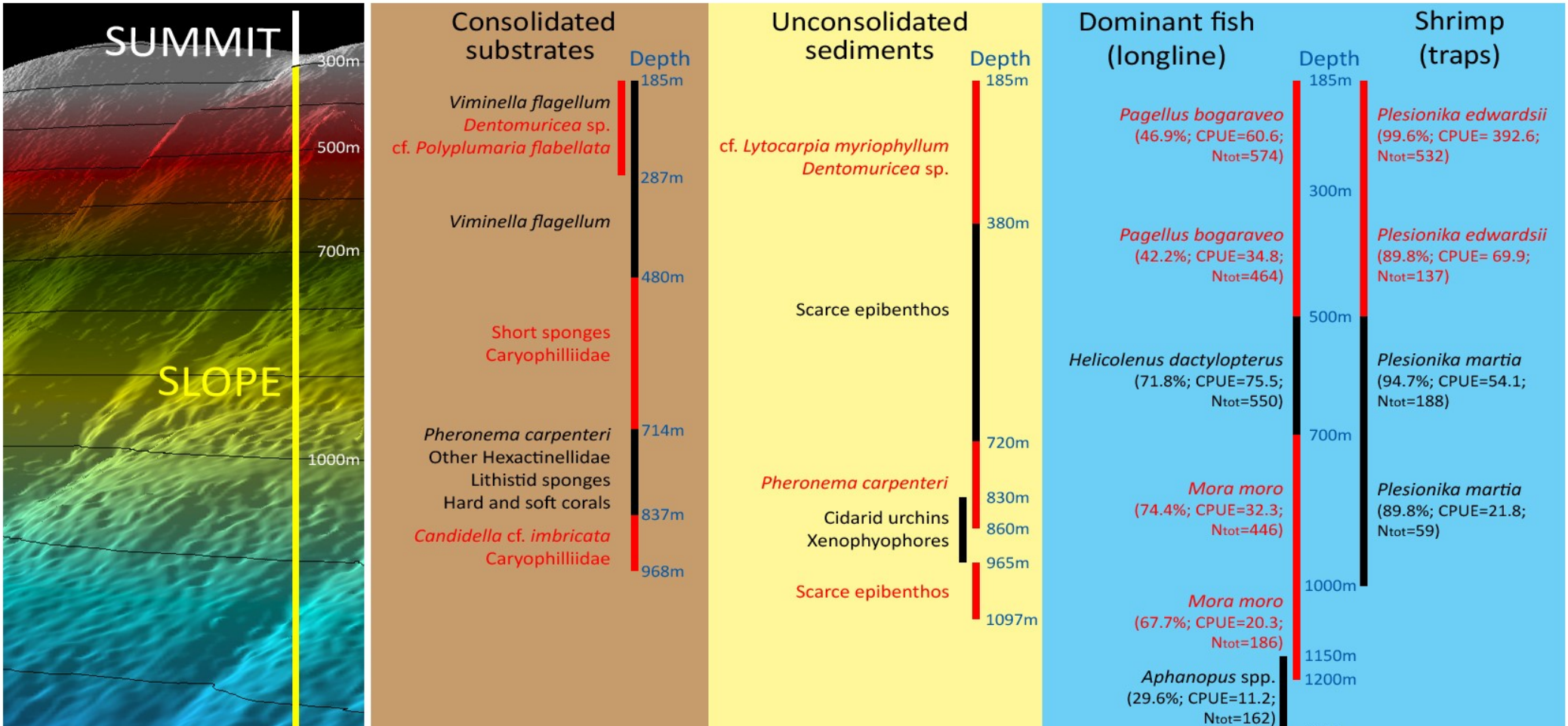


- Sponge grounds
- Background data
- Cruise opportunities

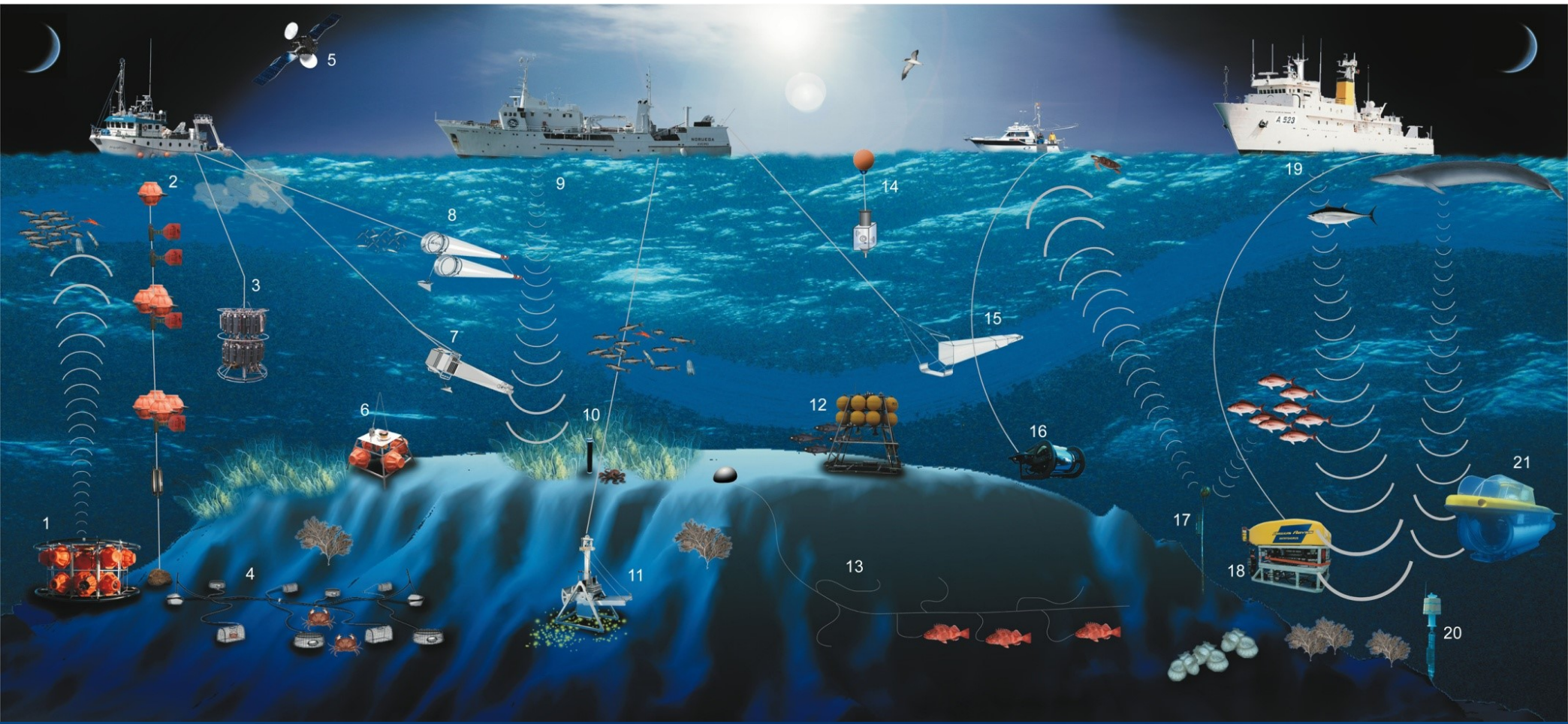
SEAMOUNT HABITAT ZONATION

- Zonation of coral gardens and deep-sea sponge aggregations depending on depth and substrate



CONDOR Observatory

Observatory for long-term study and monitoring of *Azorean* seamount ecosystems" (EEA grants financial mechanism) (2009-2012)



Cruise to Condor Seamount - RV "Águas vivas" July 2018

Objectives:

- *In situ* of oxygen uptake measurements using eddy covariance method (integrated O_2 flux over 50- 100 m^2)
- Collect seawater samples at surface and close to the seafloor for inorganic nutrients and POM
- Collection of moored sediment trap (deployed November 2017)
- Sampling of key organisms for isotope and fatty acid analysis
- …

WP2 break out session today

Initial modelling results by Christian Mohn

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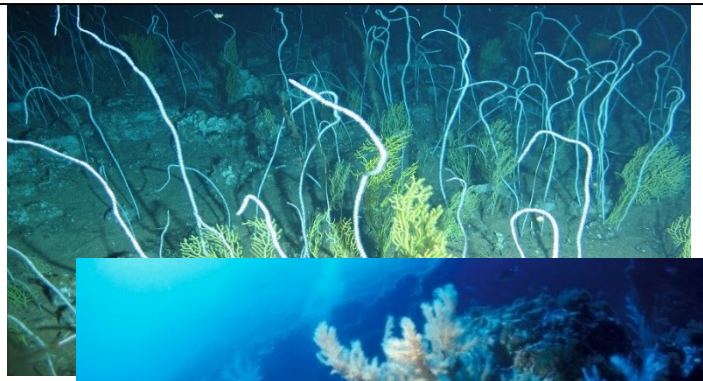
Focus habitats/species

Gorgonian garden
Viminella flagellum & Dentomuricea meteor



Black coral garden
Antipathella wollastoni

Experiments:

1. **Assimilation and processing of labeled food sources:**
   - Dissolved organic carbon
   - Phytoplankton
   - Zooplankton

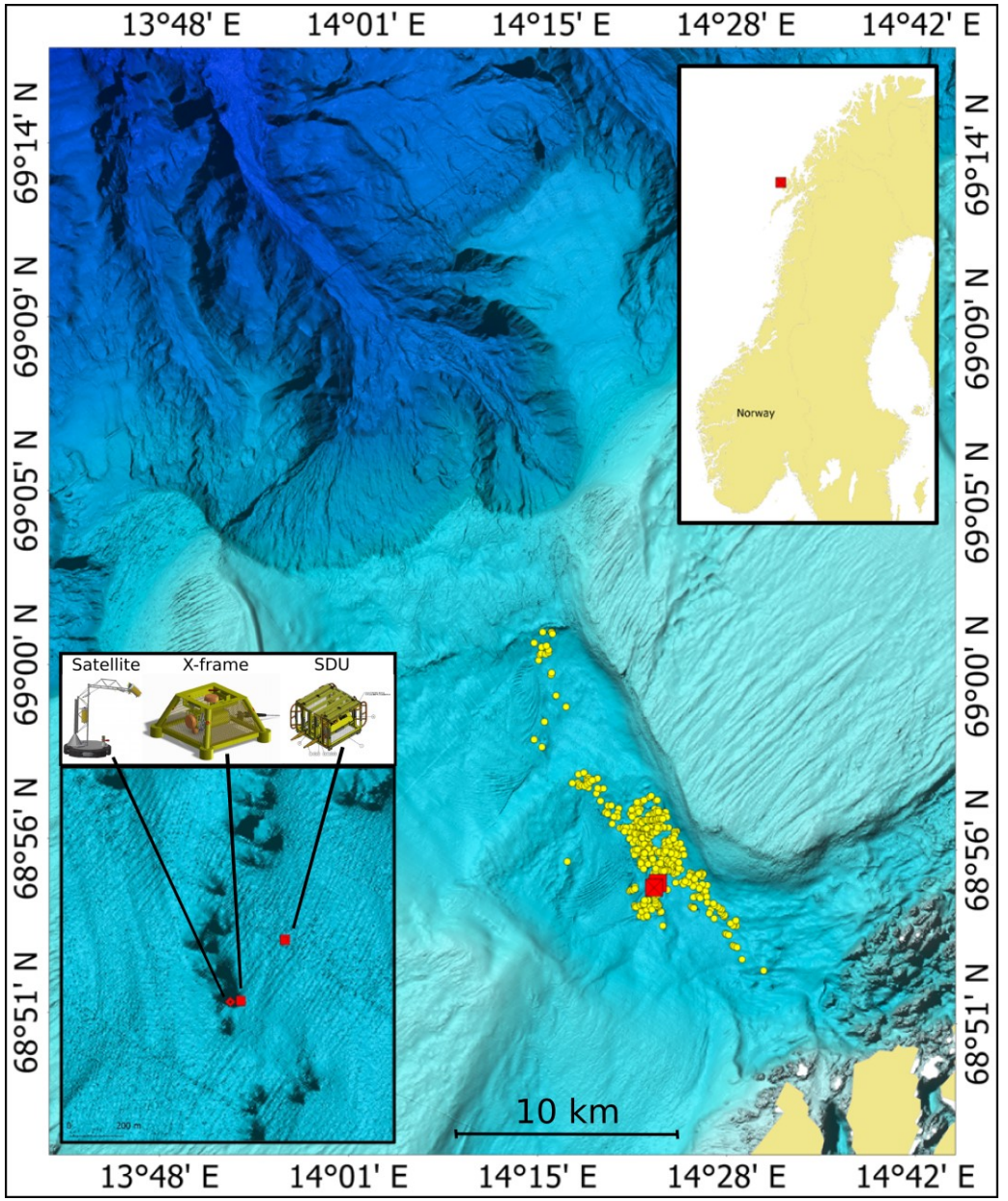
Completed, awaiting lab results

2. **Capture Rates of zooplankton**
   - Flow velocities
   - Rotifers as prey

Ongoing

Maria Rakka, Marina Carreiro-Silva et al.

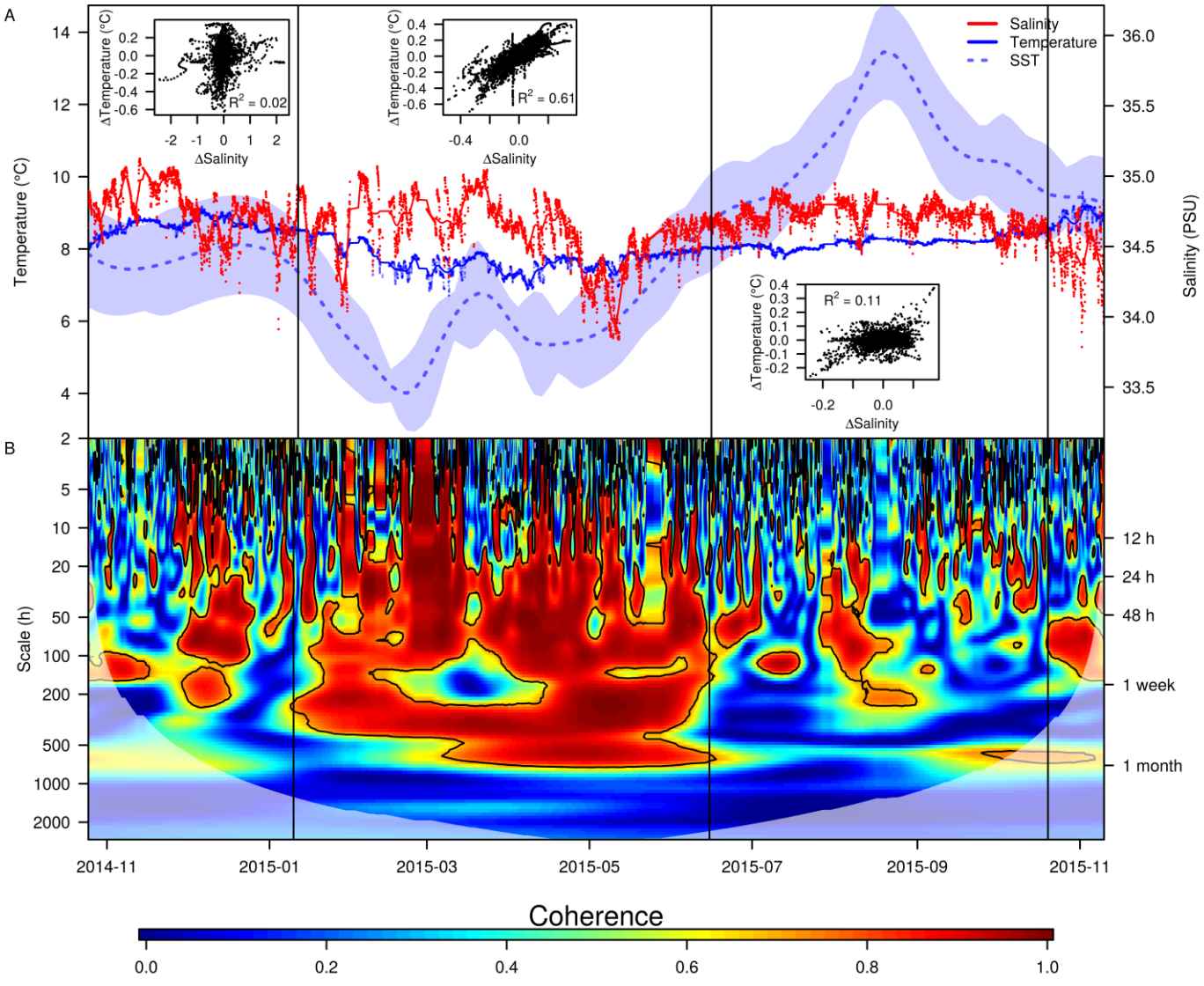
The LoVe observatory



- 180-260 m deep glacial trough
- 100-m deep banks
- 20 km off the coast
- Sand waves
- ±7-m high mounds (yellow)
- North Atlantic Current and Norwegian Coastal Water

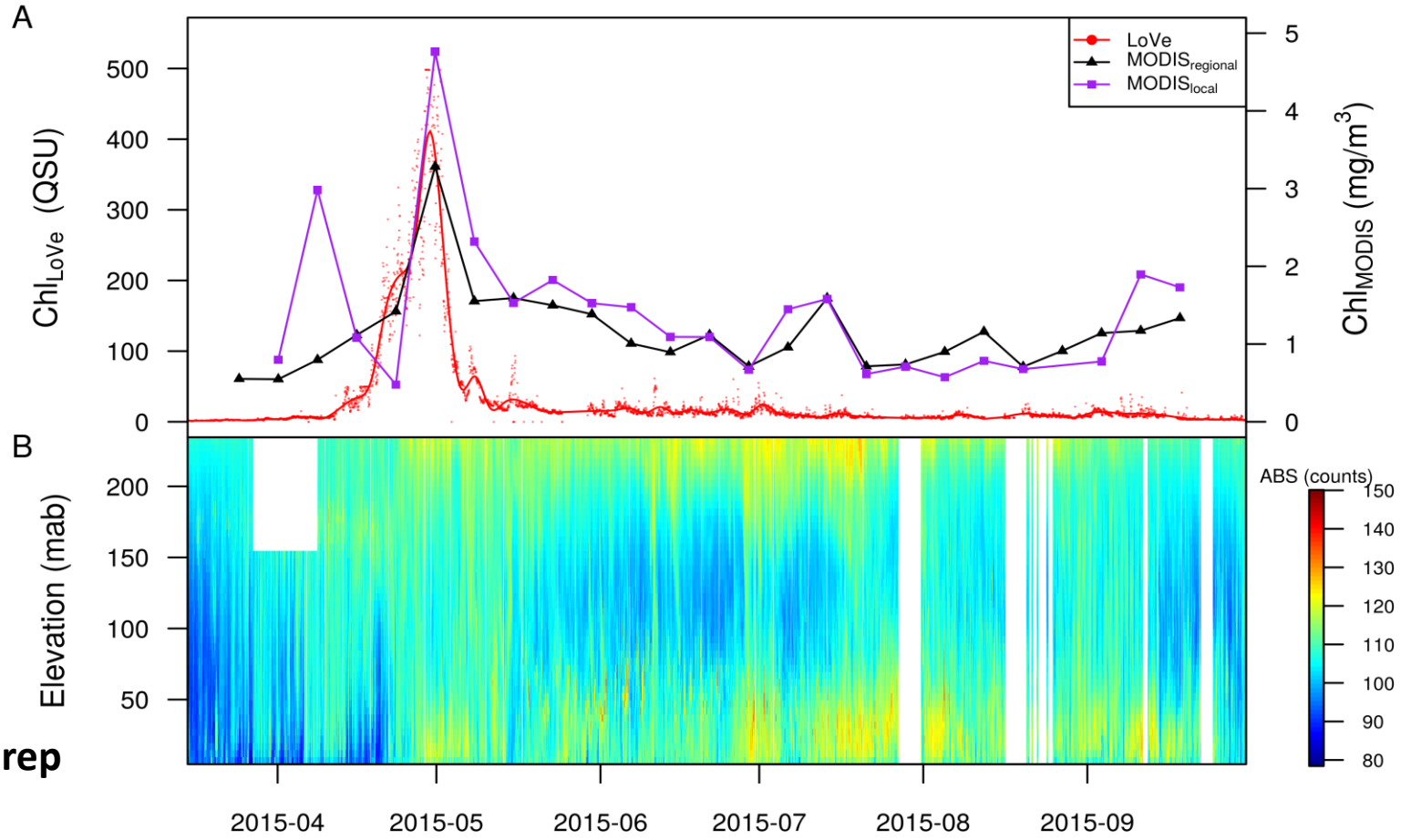
- SDU (distribution unit)
- X-frame (ADCPs, echosounder)
- Satellite unit (still camera, chl a, turbidity etc.)

Hydrography at the observatory



Van Engeland et al. In prep

Hydrography and ecology of the area



Van Engeland et al. In prep

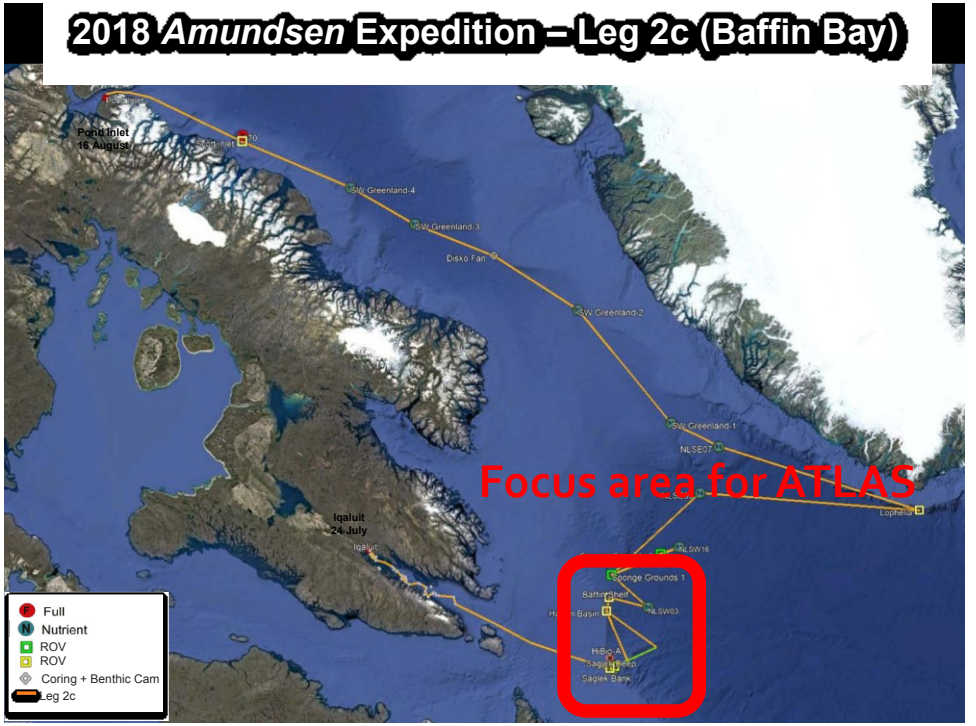
WP2 presentation by Ingunn Nilssen

Time	Topic	Presenter
09:30 - 09:45	WP2 overview	Dick van Oevelen
09:45 - 10:00	LoVe observatory	Ingunn Nilssen
10:00 - 10:15	Application of the Eddy covariance method	Lorenzo Rovelli
10:15 - 10:30	Oxygen and nutrient fluxes at Rockall Bank	Evert de Froe
10:30 - 10:45	Control of CWC distribution by food quality?	George Wolff
10:45 - 11:00	HR ROMS model of Rockall and Condor	Christian Mohn
11:45 - 13:45	Breakout session – Cruises to Davis Strait and Condor	

Breakout session WP2:

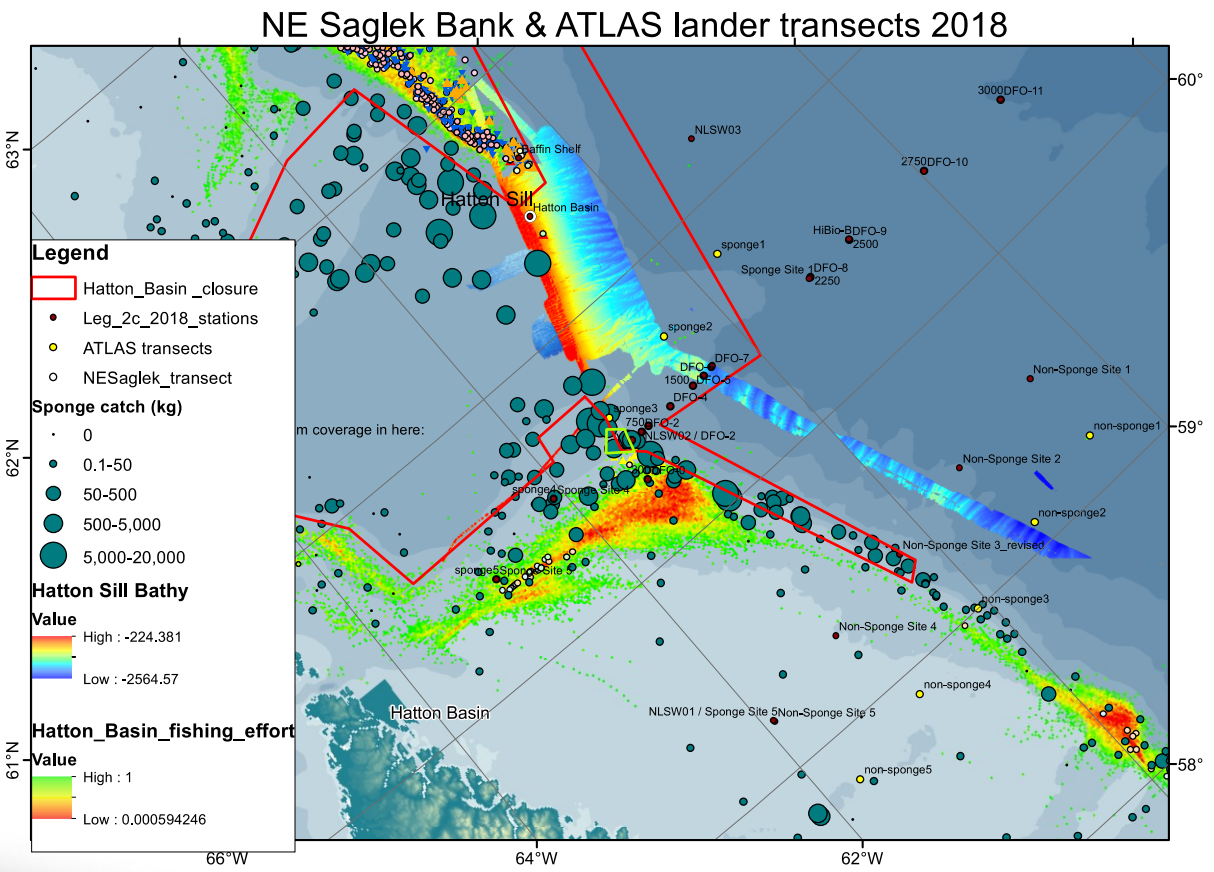
Cruises to Davis Strait and Condor seamount

Cruise track – leg 2C Amundsen 2018



- 3.5 days of leg 2C will be for ATLAS work
- We will team up with Memorial U/DFO/ArcticNet for data sharing
- Focus area for ATLAS is indicated in the red rectangle
- Two berths available for ATLAS: Sabena Blackbird (ULIV) and Graham Tulloch (BGS)

Lander locations and CTD transects



This map includes two ATLAS lander stations + transects:

- stations sponge1-5 (yellow dots), #3 = lander station
- non-sponge site revised 1-5 (darkred dots), #3 = lander station

The non-sponge transect was revised to ensure that the lander could be placed in a trawl closure. The site has reduced sponge biomass as the ‘sponge site’, but is not devoid of sponges. So we aim for two stations with a clear contrast in sponge abundance.

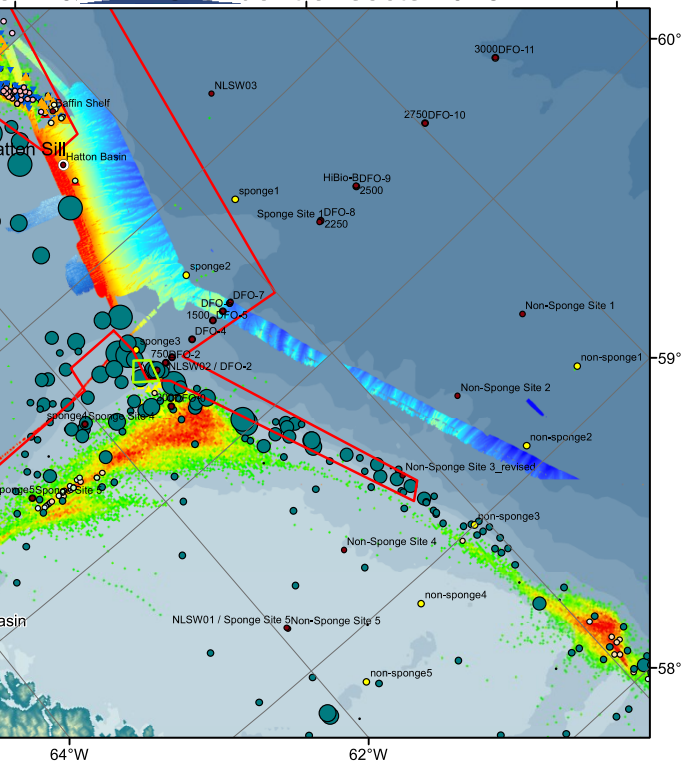
Equipment on the landers

- Landers will be deployed for 1 year
- Landers will be deployed close to the seafloor using an acoustic release for accurate positioning. If we keep the pick-up line short then we can approach the landers with the ROV. Likely we will 'only' get a pre-dive ROV dive to find a good location.
- Equipment per lander (2,000 m rating)
  - Flash / radio beacon / 2 releases / floats
  - CTD
  - Oxygen sensor
  - Turbidity
  - Sediment trap (12 bottles)
  - Aanderaa Z-pulse current meter
  - single-point Aquadopp DW 3000 (GW)
  - Upward looking long-range ADCP - Flowquest 75kH (range up to 900 m - 1 available (GW)

Equipment on the landers

- Fluorometers would be very advantageous. Suggestions?
- Fixative for the sediment traps? Formaldyhyde as at Condor?
- Time intervals for sediment traps? 12 bottles -> 1 per month
- Height of the O2, flow meter and Aquadopp on the lander? 80-100 cmab
- One upward looking ADCP. Deploy on lander in high-sponge ground?
- Shipping of Aquadopp and ADCPs?
- Possibility to sample Lophelia pertusa at the Greenland reef for genomics. Discussed with Sophie

Lander stations and CTD transects



The organic matter and food distribution across the shelf stations (see map above) will be monitored with two activities

1. In situ pump (SAPs) are cancelled as only one was available
2. Two CTD shelf/slope transects across the lander stations (5 CTD points for each transect) will be done, with sampling at 5 depths for:
   - Nutrients + DOM
   - POM + pigments
   - Bacterioplankton (flow cytometer)
   - Other variables?
3. Time permitting, we will also get a few CTD+niskin station along the shelf ridge between the lander stations.

- CTD transect after the lander deployments so that POC sampling can be used to calibrate the particle counts from the ADCP
- Sampling vials/filters; can these be ordered from Canada to avoid excessive transport costs?
- Filtration unit; Available for use on Amundsen? George has one available if necessary. Other cruise participants will help with the filtration and sample processing

Seafloor mapping and sampling

The ROV time will be used for three tasks around the lander sites:

1. Seafloor imaging to confirm (non)-sponge ground locations. We will probably only get a pre-deployment dive
2. Approaching the lander to check proper positioning (if possible / allowed). Likely no time.
3. Opportunity to sample dominant organisms for isotope/fatty acid analysis. DvO has contacted student from Canada (Catie Young) for cooperation. Johanne Vadd/Georgios have contacted her for sponge samples.

- Which species are recommended for fauna sampling? DvO will discuss this further with Catie

Time line and important info:

- Final shipping to Aanderaa: **20 March**
- **Lander shipping: 22-23 March**
- Berths: *TBA* (**) and Sabena Blackbird (ULIV)
- In Canada: Lander build up with help from Barry (DFO) and possibly TechAss (NOAA is supportive)
- Build-up + training on landers **early May**
- Deadline for security clearance: not clear, but we will start this process now
- Loading the ship in Quebec: **11-May (+ potentially a few days extension)**

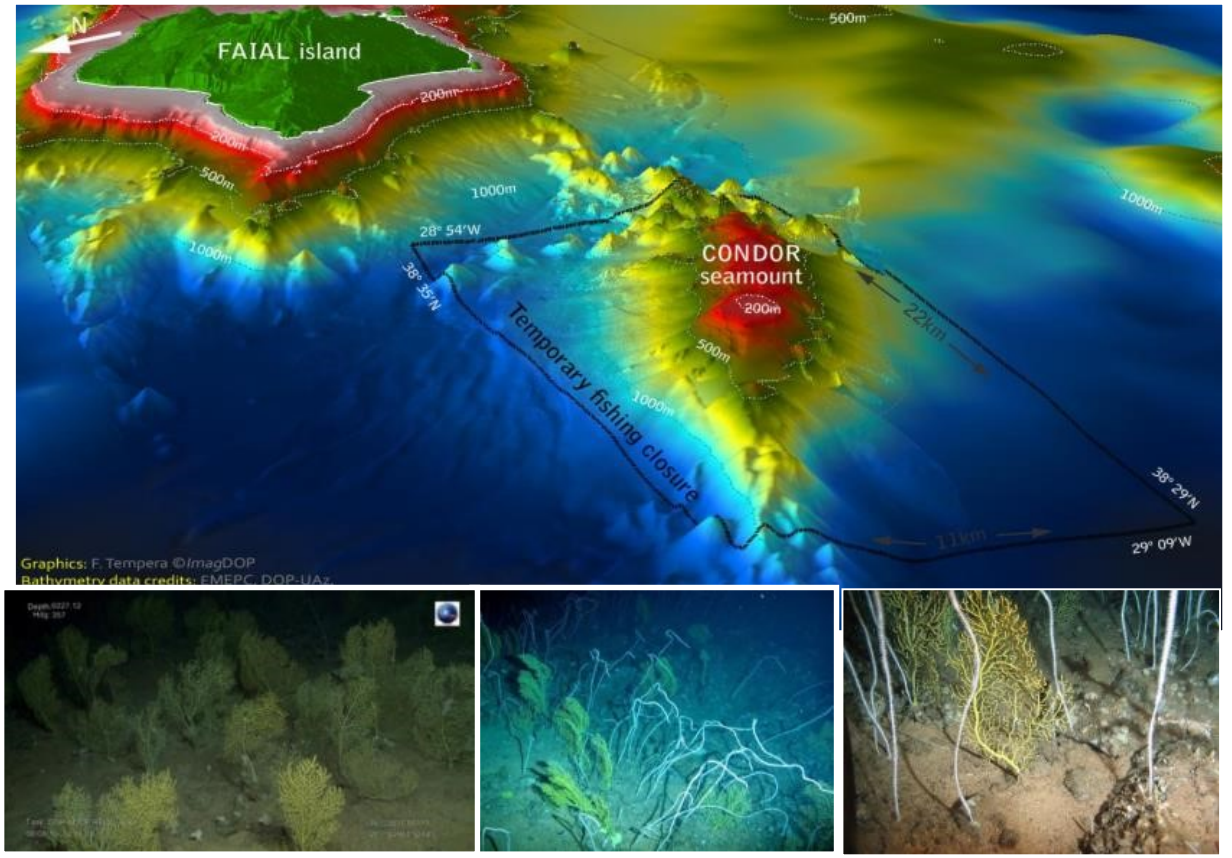

atlas

Breakout session WP2

Condor Seamount campaign

Summer 2018

Condor Seamount

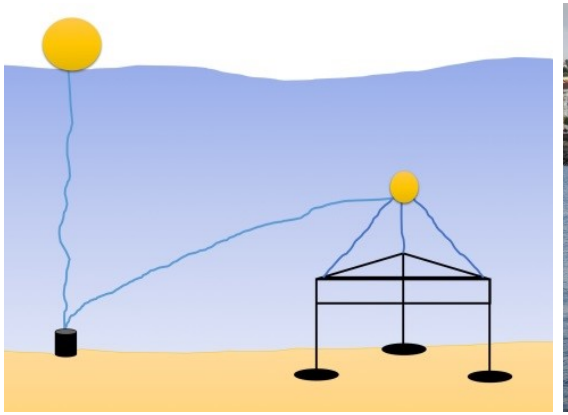


Target area:

Coral gardens at the summit of the seamount between 190-210 m depth

AEC work

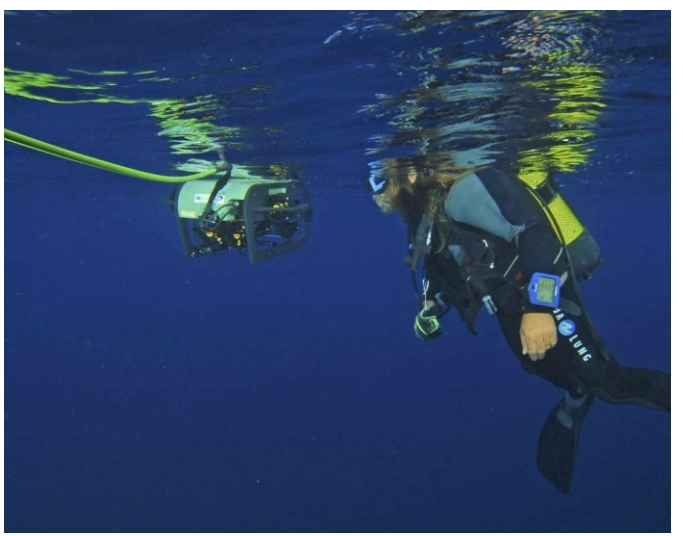
- Use of vessel Águas vivas (11 m)
- Daily deployments with daily trips to Condor Seamount
- Use of a portable Niskin bottle deployed by hand for seawater collection (POM, NUTs, pigments)



Collection of benthic fauna

- Collection of the two dominant gorgonians (*Dentomuricea meteor* and *Viminella flagellum*) with small ROV from the same areas visited with AEC

- Possibility of using samples of same coral species collected in previous years from the Condor seamount



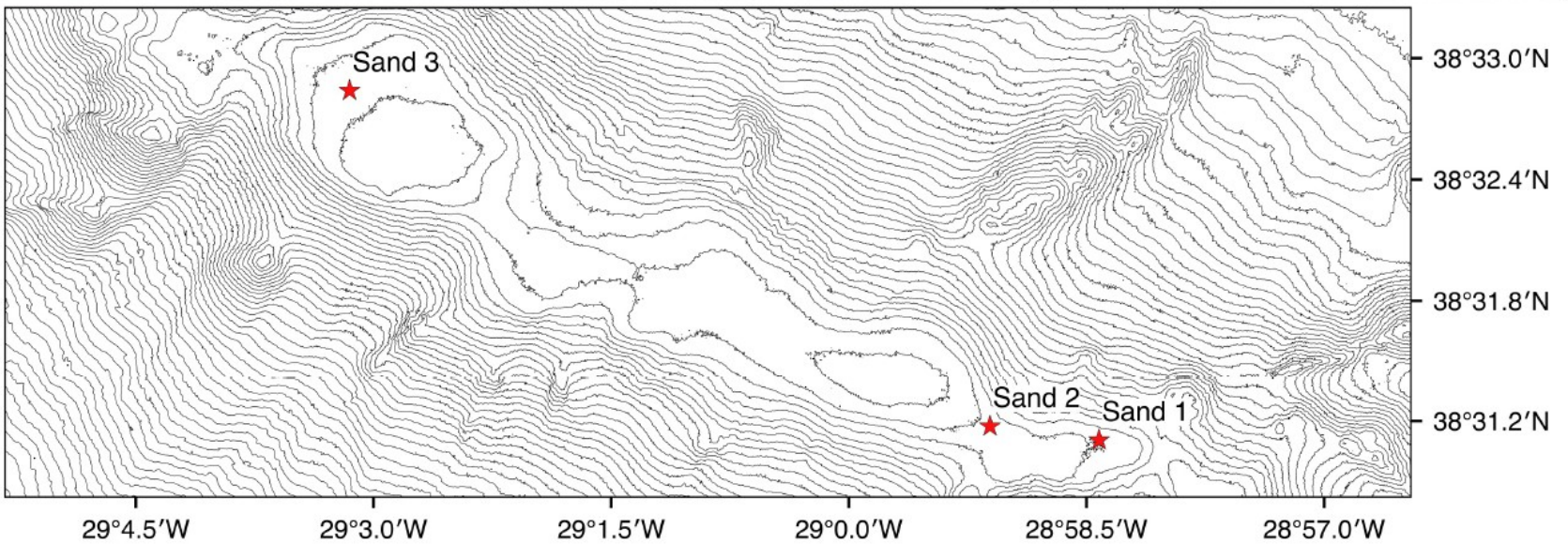
Potential Areas

Sand

Location 1
Lat: 38,517865
Lon: -28,9737904
Depth: 258 m
Length of patch: 50 m

Location 2
Lat: 38,5188092
Lon: -28,9852987
Depth: 236 m
Length of patch: 51 m

Location 3
Lat: 38,5454155
Lon: -29,0534654
Depth: 205 m
Length of patch: 194 m



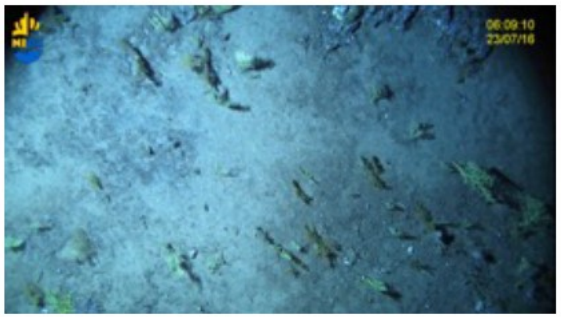
Potential Areas

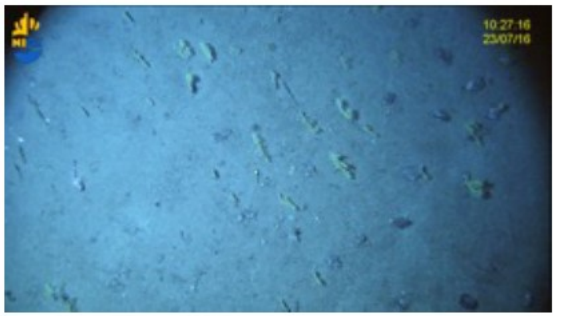
Dentomuricea aff. *meteor*

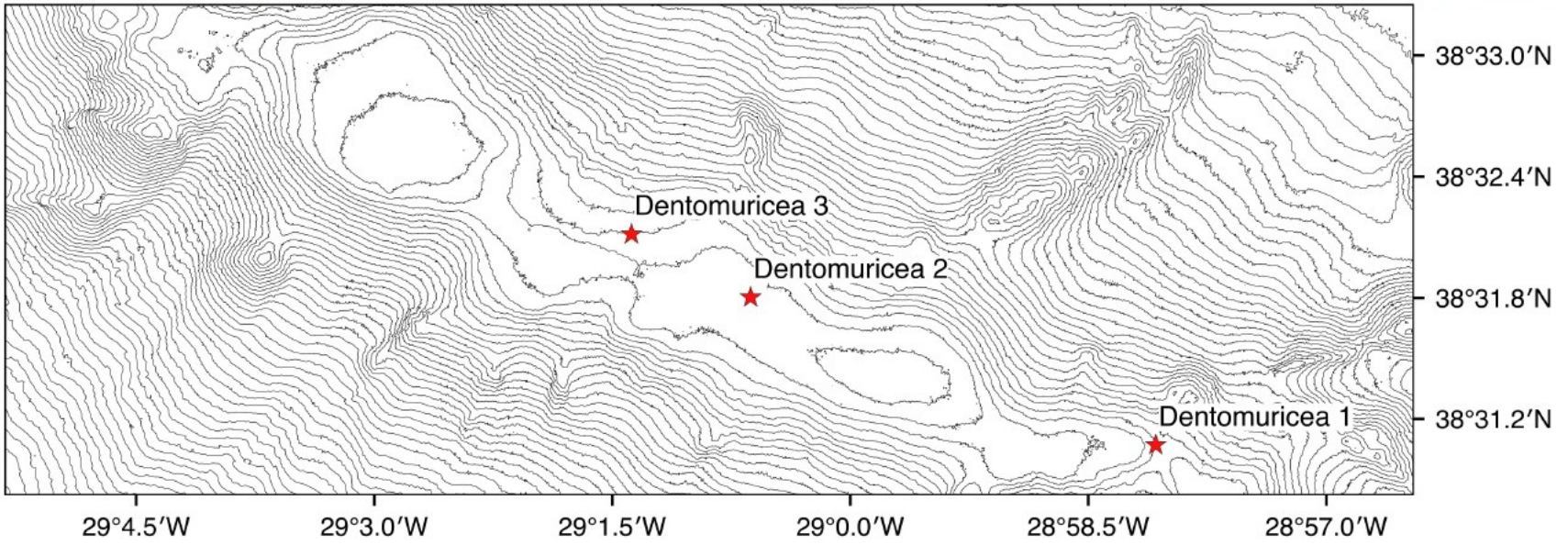
Location 1
Lat: 38,5173755
Lon: -28,9680136
Depth: 297 m
Length of patch: 56 m

Location 2
Lat: 38,52886019
Lon: -29,01091293
Depth: 250 m
Length of patch: 76 m

Location 3
Lat: 38,53384983
Lon: -29,02357627
Depth: 255 m
Length of patch: 83 m







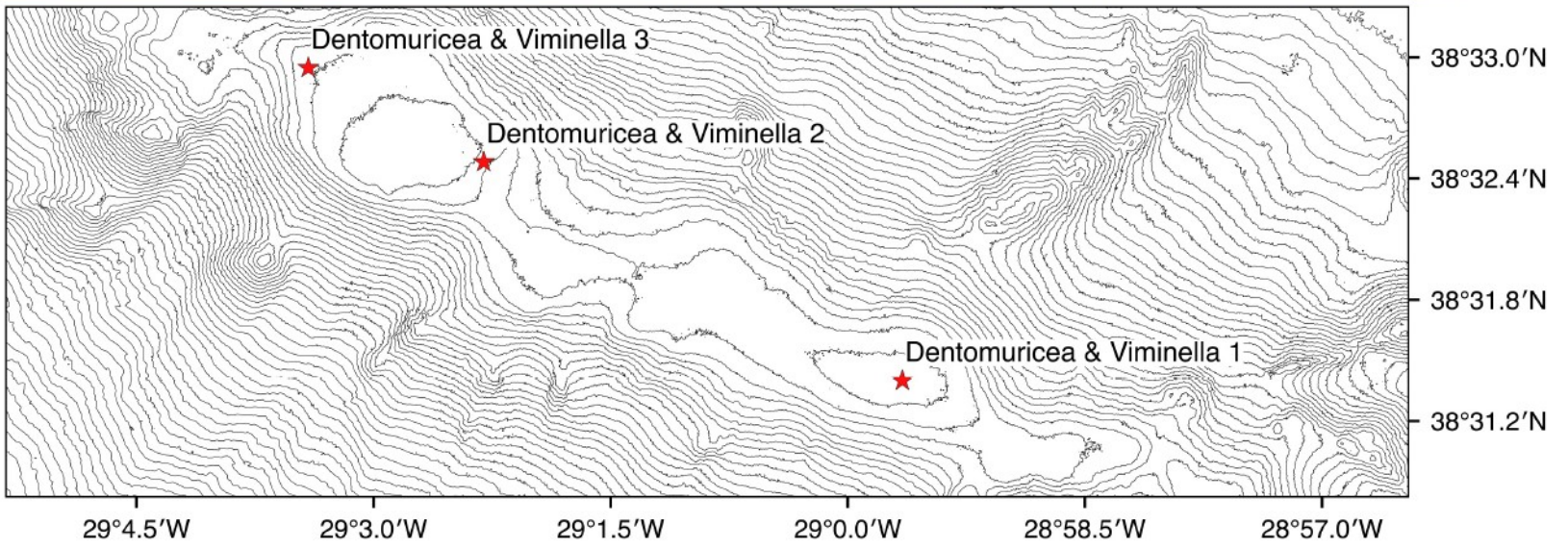
Potential Areas

Dentomuricea aff. *meteor* & *Viminella flagellum*

Location 1
Lat: 38,52242867
Lon: -28,9945053
Depth: 208 m
Length of patch: 64 m

Location 2
Lat: 38,53968878
Lon: -29,03915542
Depth: 204 m
Length of patch: 130 m

Location 3
Lat: 38,5471429
Lon: -29,0578833
Depth: 221 m
Length of patch: 38 m

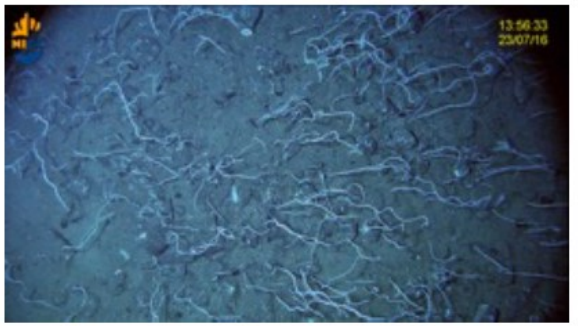


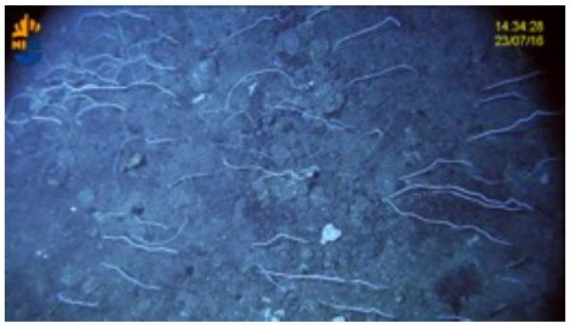
Viminella flagellum

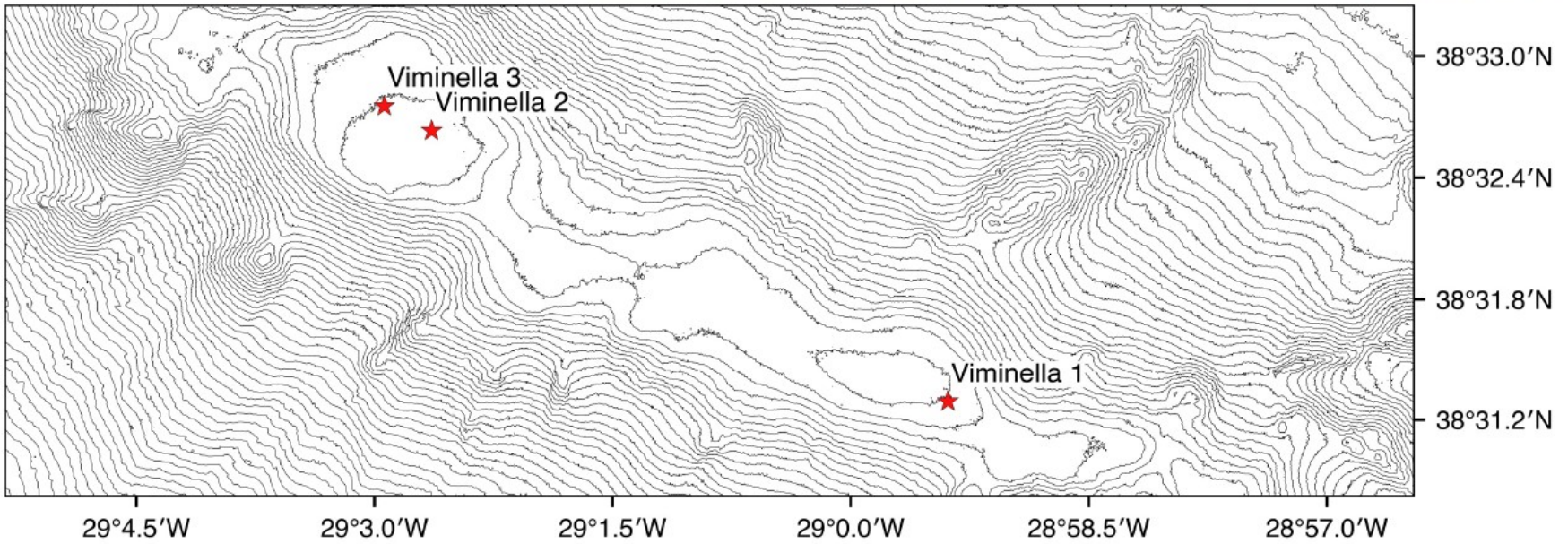
Location 1
Lat: 38,5206927
Lon: -28,9899955
Depth: 218 m
Length of patch: 12 m

Location 2
Lat: 38,54210905
Lon: -29,0448418
Depth: 190 m
Length of patch: 14 m

Location 3
Lat: 38,54404496
Lon: -29,0498782
Depth: 192 m
Length of patch: 142 m

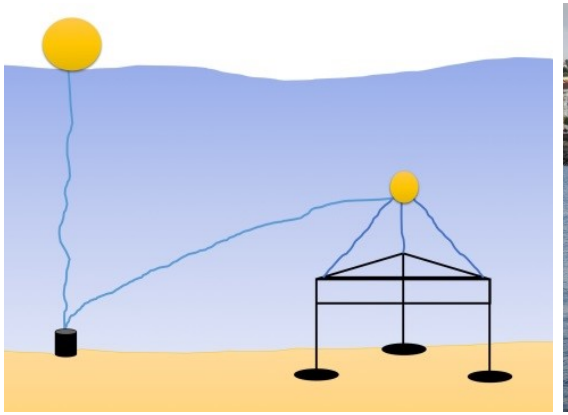






AEC work

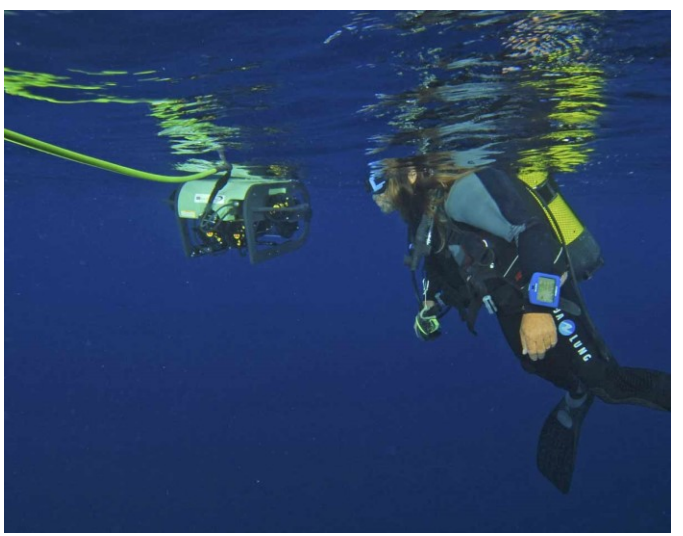
- Use of vessel Águas vivas (11 m)
- Daily deployments with daily trips to Condor Seamount
- Use of a portable Niskin bottle deployed by hand for seawater collection (POM, NUTs, pigments)



Collection of benthic fauna

- Collection of the two dominant gorgonians (*Dentomuricea meteor* and *Viminella flagellum*) with small ROV from the same areas visited with AEC

- Possibility of using samples of same coral species collected in previous years from the Condor seamount



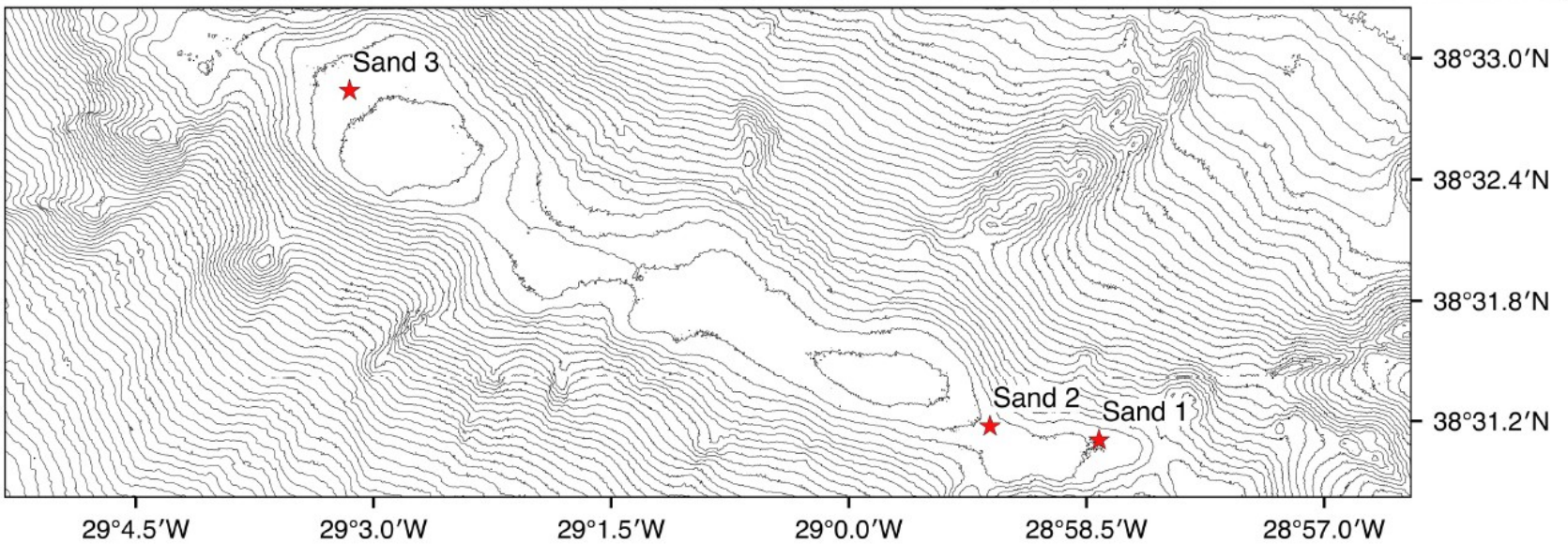
Potential Areas

Sand

Location 1
Lat: 38,517865
Lon: -28,9737904
Depth: 258 m
Length of patch: 50 m

Location 2
Lat: 38,5188092
Lon: -28,9852987
Depth: 236 m
Length of patch: 51 m

Location 3
Lat: 38,5454155
Lon: -29,0534654
Depth: 205 m
Length of patch: 194 m



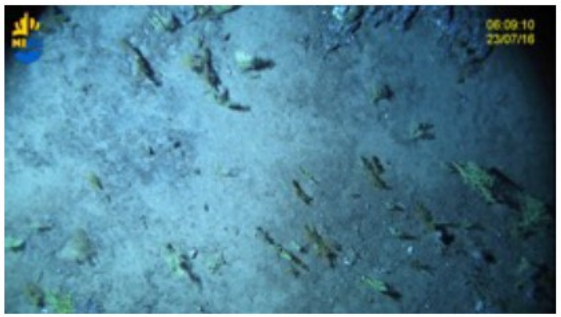
Potential Areas

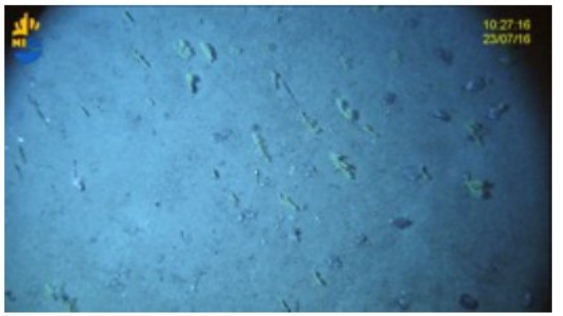
Dentomuricea aff. *meteor*

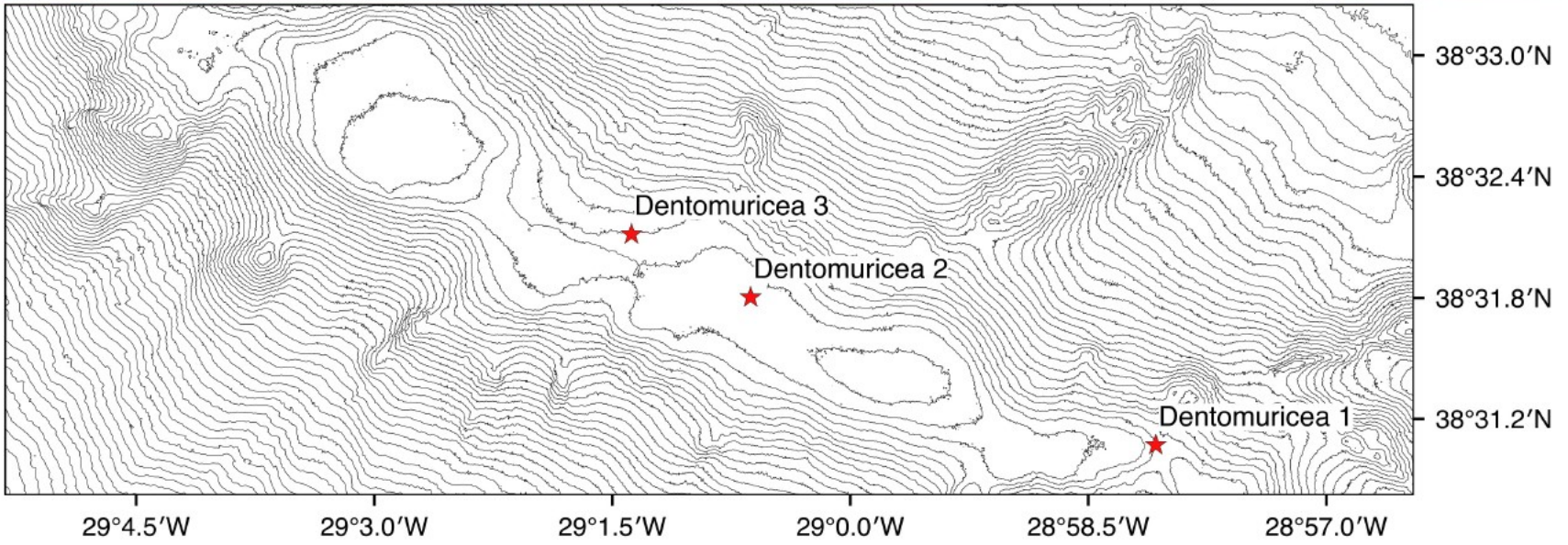
Location 1
Lat: 38,5173755
Lon: -28,9680136
Depth: 297 m
Length of patch: 56 m

Location 2
Lat: 38,52886019
Lon: -29,01091293
Depth: 250 m
Length of patch: 76 m

Location 3
Lat: 38,53384983
Lon: -29,02357627
Depth: 255 m
Length of patch: 83 m







Potential Areas

Dentomuricea aff. *meteor* & *Viminella flagellum*

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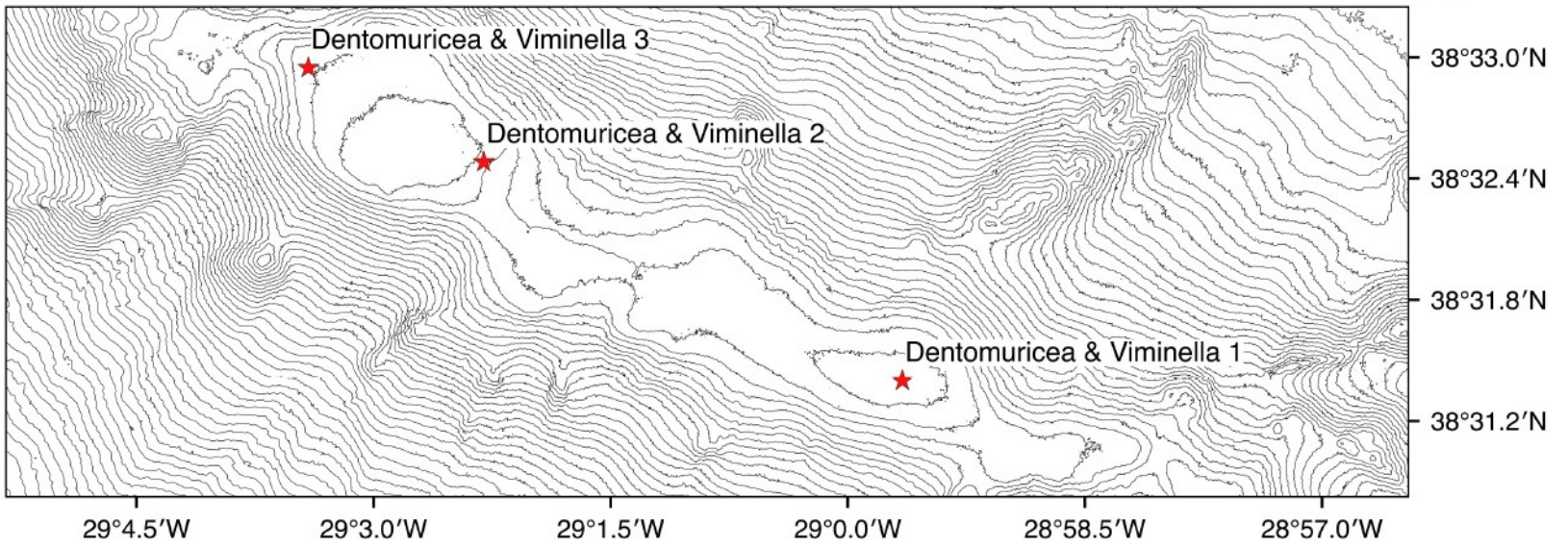

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Depth: 190 m
Length of patch: 14 m

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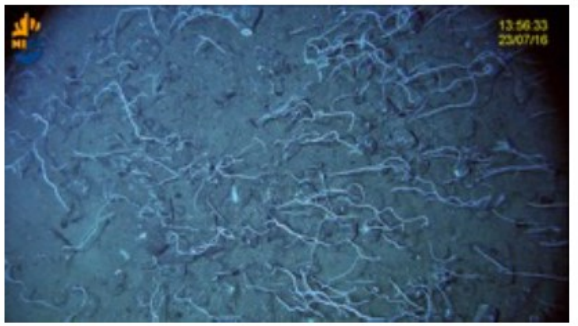
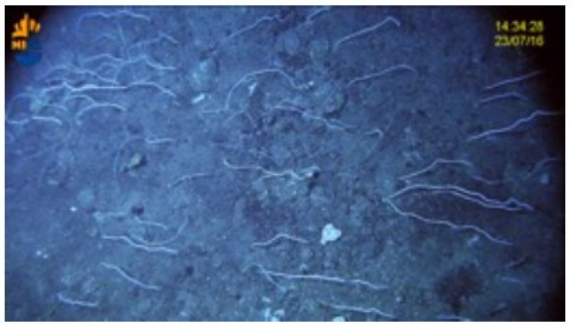
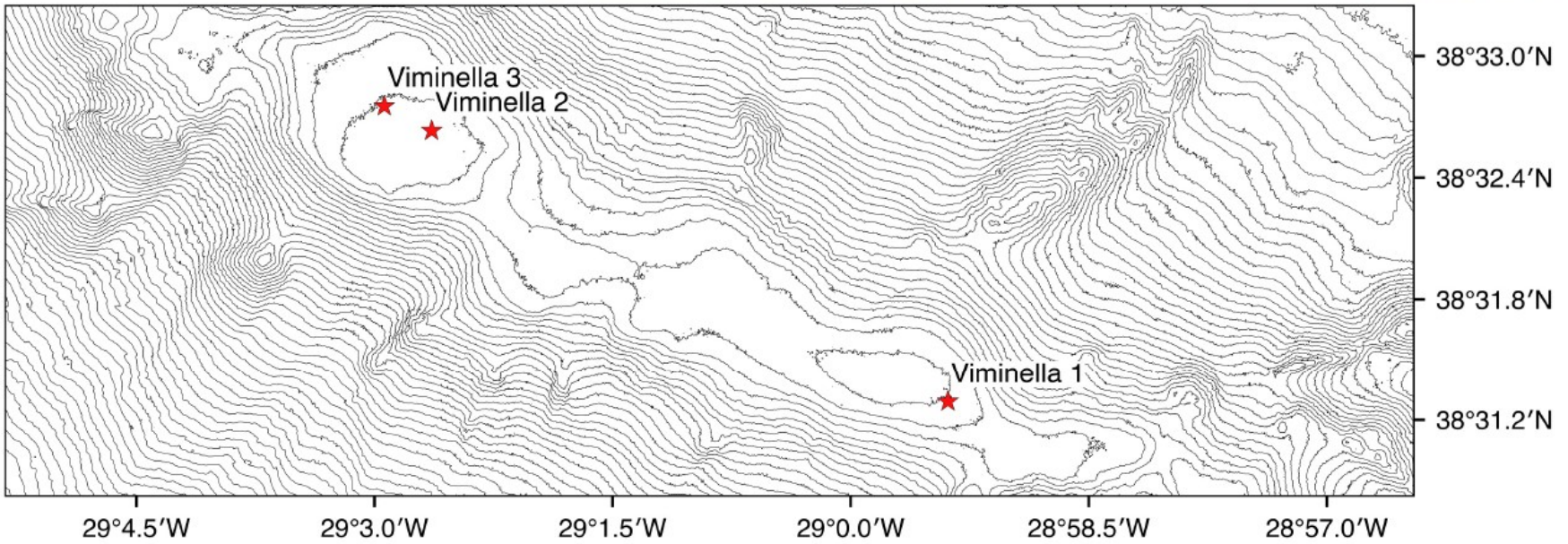
Lat: 38,54404496
Lon: -29,0498782
Depth: 192 m
Length of patch: 142 m







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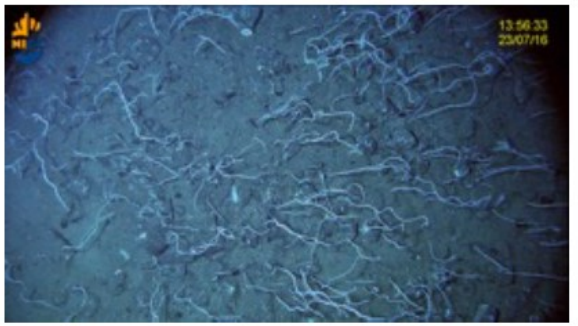
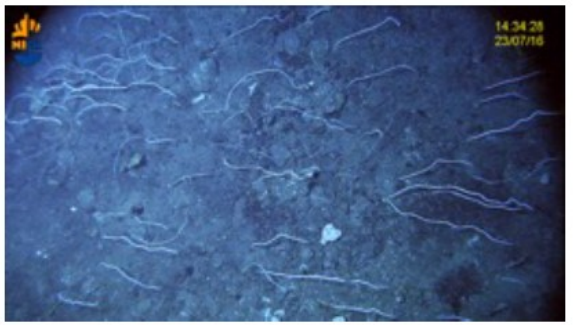
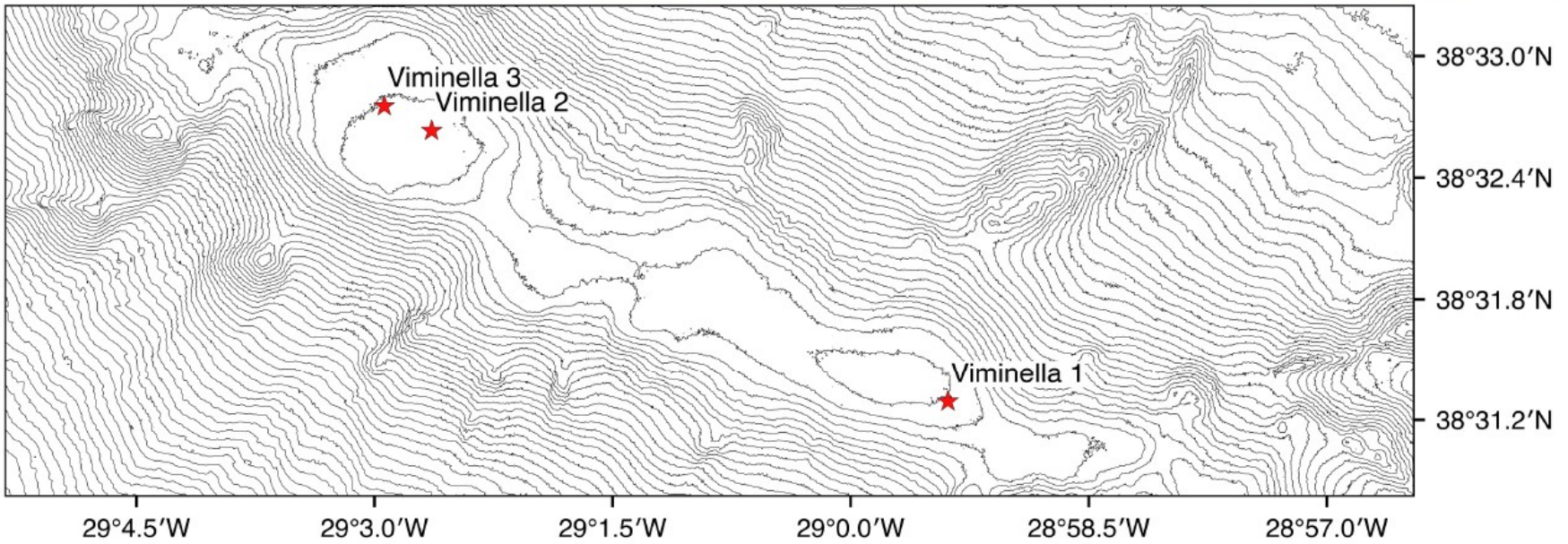


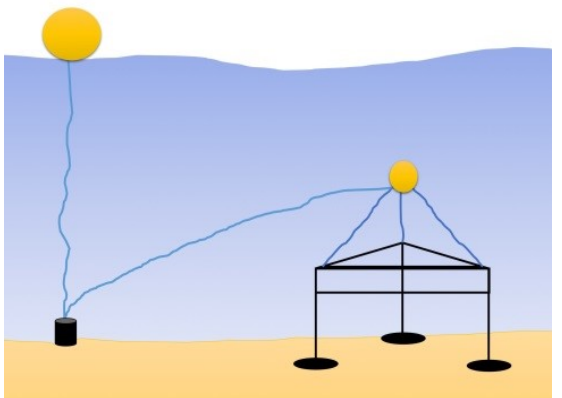




Work during July cruise

- Use of vessel Águas vivas (11 m)
- Daily trips to Condor Seamount
- Use of a portable Niskin bottle deployed by hand for seawater collection (POM, NUTs, pigments)
- Collection of fauna with small ROV from seamount summit

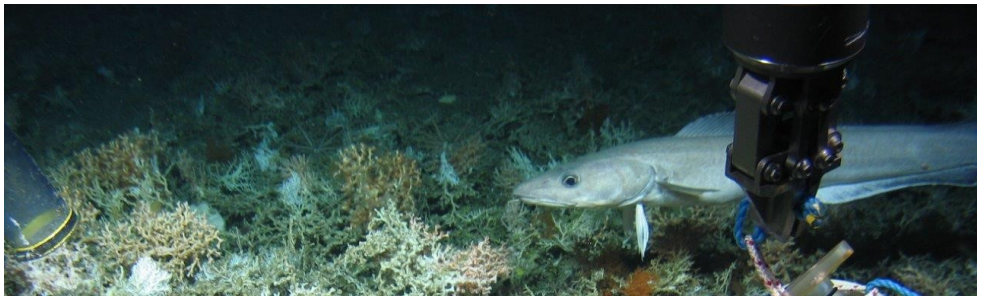
Planned activities:



- Deployment of AEC frame on a line
- ROV inspection of locations
- Collection of the two dominant gorgonians (*Dentomuricea meteor* and *Viminella flagellum*) with small ROV from the same areas visited with AEC
- Possibility of using samples of same coral species collected in previous years from the Condor seamount
- Faunal analysis of stable isotopes/fatty acids/… - GW?
- Other requests?

ATLAS Workshop - Modelling connectivity

29 – 30 January 2018
Location: Room 304 Crew Building, Grant Institute, University of Edinburgh



Number	Description	Month	Lead
D2.1 ✓	Compilation of existing physiological data on CWC response to different conditions of food supply and oceanographic change scenarios	M8	IEO
D2.2	Detailed analyses of uptake of different food sources into the tissue of key habitat-forming species from isotope experiments	M24	NIOZ
D2.3	Report on in situ hydrodynamics, abiotic variables, and suspended particles near the seafloor and sedimenting particles from bottom traps. Fluorescence and backscatter data reported as proxies for phytodetritus and zooplankton	M30	NIOZ
D2.4	Experimental data on the physiological response of different types of benthic communities under predicted environmental changes including ocean acidification, temperature and food supply	M33	IEO
D2.5	Biogeochemical characterisation (lipid and amino acid composition) of the OM and faunal at the different study sites	M33	ULIV
D2.6	Community respiration rates based in situ O2 consumption rates as a function of location, season, C supply and community characteristics	M36	USD
D2.7	Quantitative assessment of near-seafloor flow dynamics and physical drivers of food availability based on high-resolution hydrodynamic modelling to verify use of VIKING20 in SDMs to proxy food supply	M38	AU
D2.8	Integrative and coupled model based on hydrodynamics, biogeochemistry and physiology for the prediction of biomass and biogeochemical dynamics, projections under future oceanic conditions and marine spatial planning	M40	NIOZ

Experimental Strategy

- Identify periods of extreme AMOC states from analysis of VIKING20 model output (1958 – 2009).
- Create boundary conditions from VIKING20 data for local area models.
- Quantify hydrodynamic controls, organic matter supply and ecosystem response to changing AMOC using high resolution models in focus areas.
- Use experimental data from ATLAS and historical data to validate models.

Cabled observatory in the Lofoten-Vesterålen region on the Norwegian shelf

From Norway with LoVe

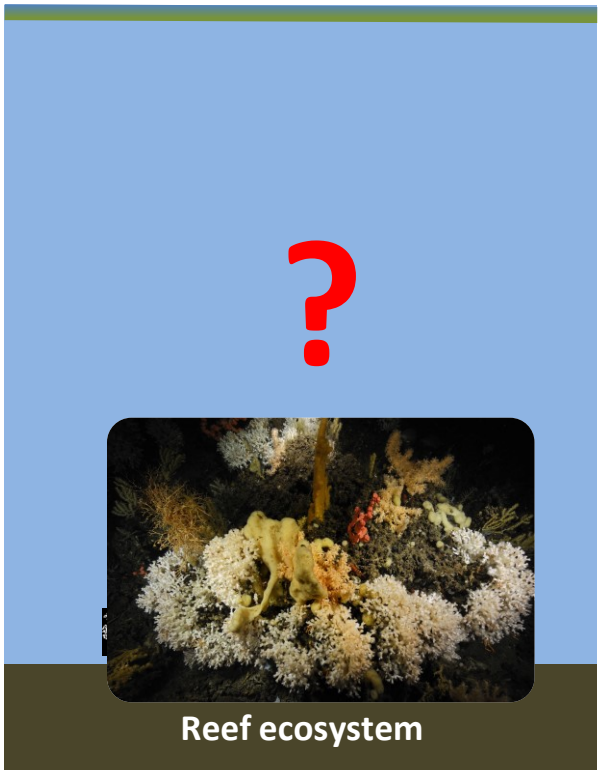
Rationale:

Adaptive ecosystem-based management approaches require an understanding of ecosystem function, distribution and connections and how these may be altered by changes in food supply, climate and resource exploitation.

External factors:

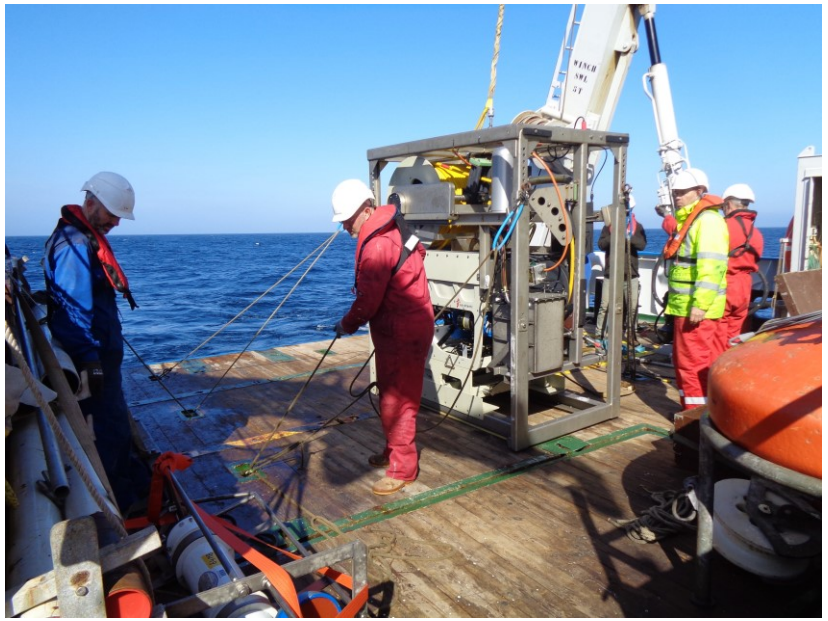
- Food supply
- Ocean acidification
- Temperature
- Resource extraction

years/decades



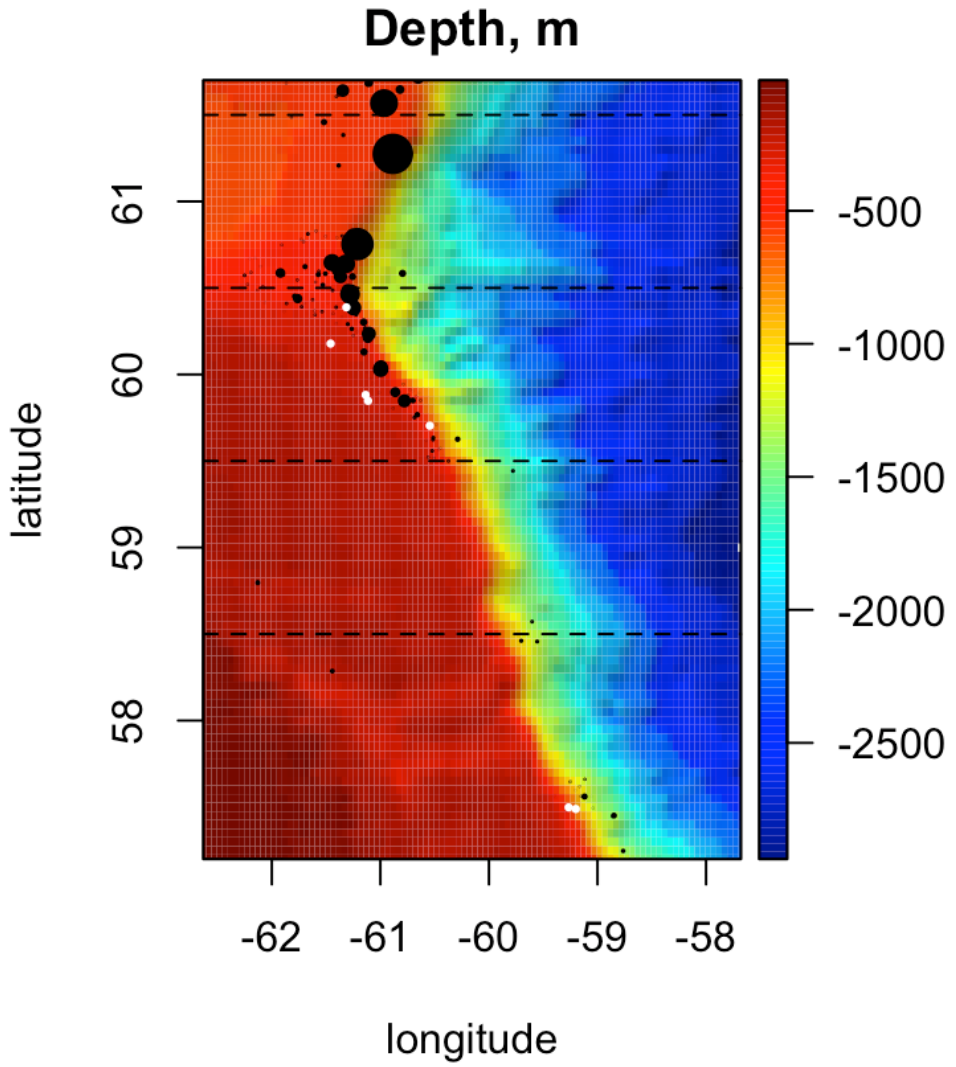
atlas

RV *Pelagia* cruises (2017/2018)



Faunal sampling and seafloor mapping with ROV Genesis

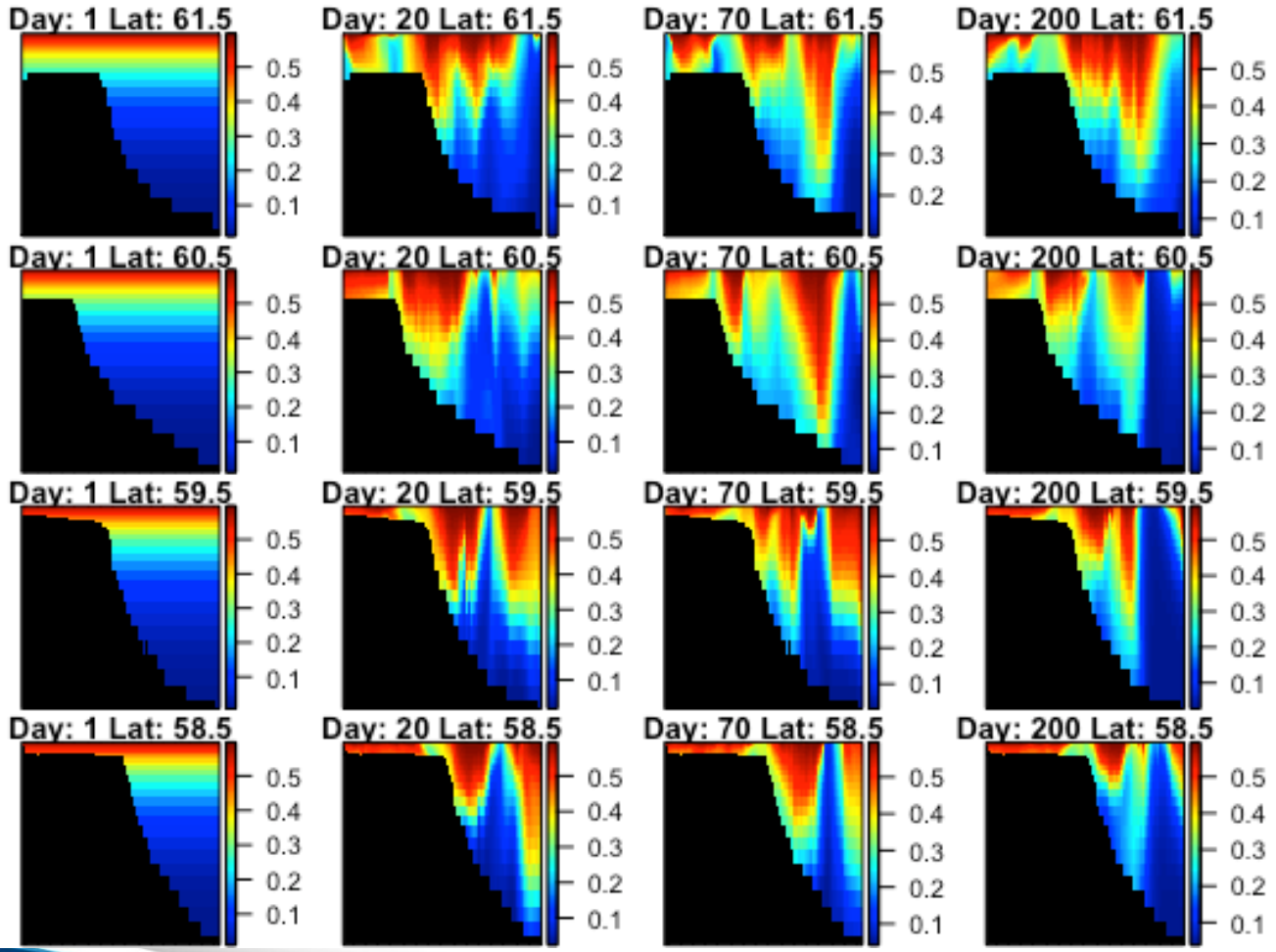
Task 2.2 OM characterisation and mineralisation
Task 2.3 Experimental physiology



- **Selected area for organic matter (OM) transport modelling around the sponge grounds.**
- **Black circles are proportional to sponge biomass, white circles are 'no sponges'**

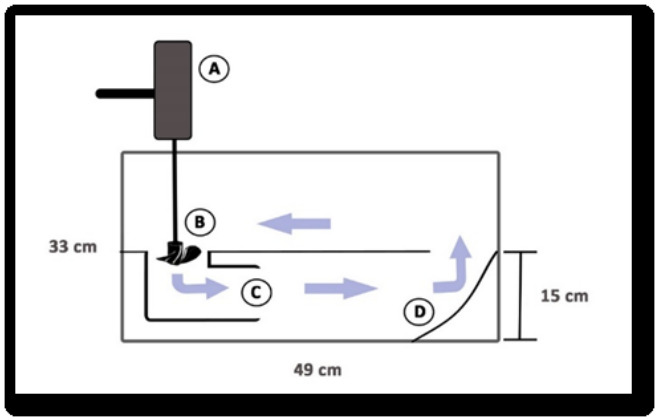
atlas

OM dynamics during 6-months simulation

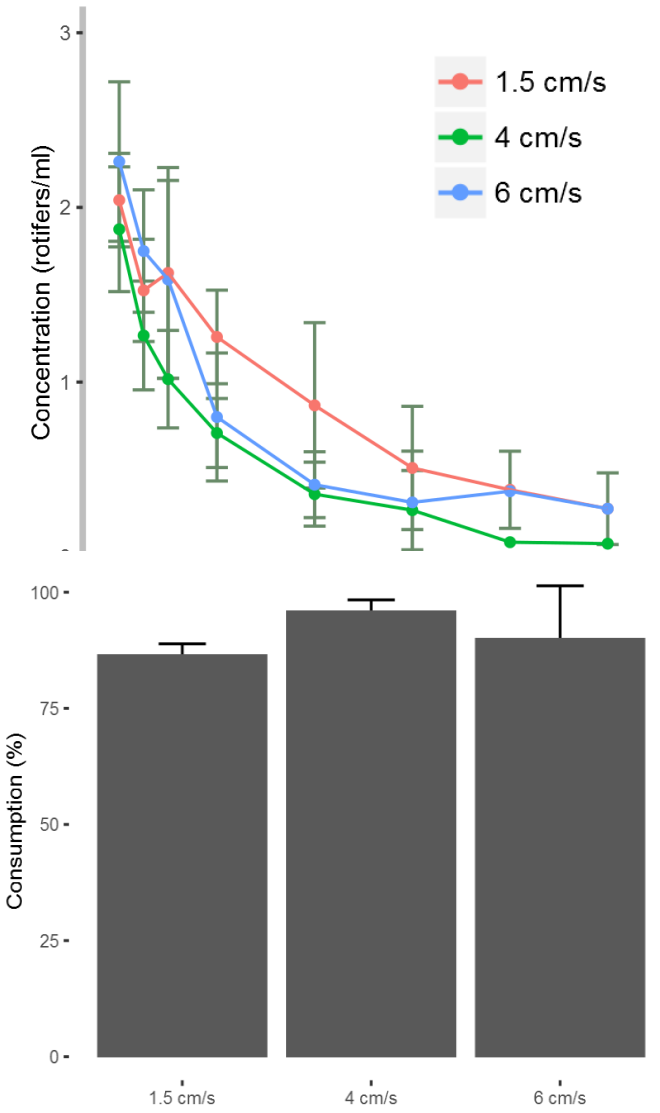


Need for field validation!

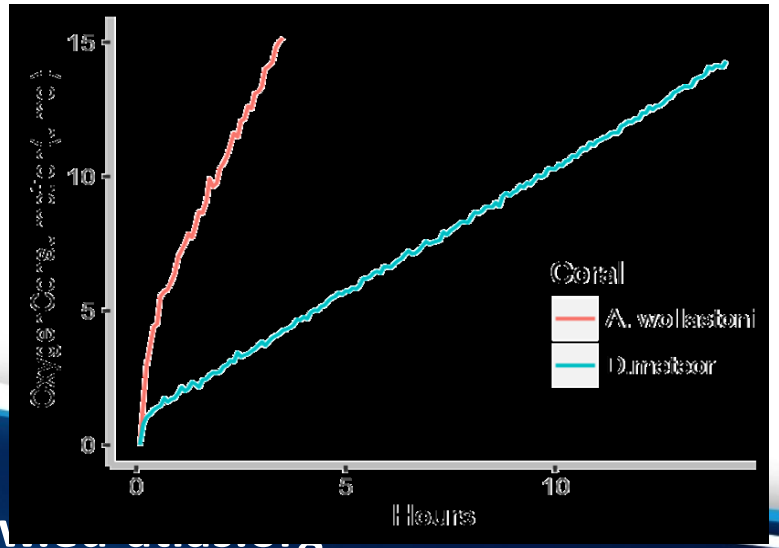
Experimental flume



Preliminary Results: Capture Rates



Preliminary Results: Respiration



A. wollastoni

Hydrography and ecology of the area