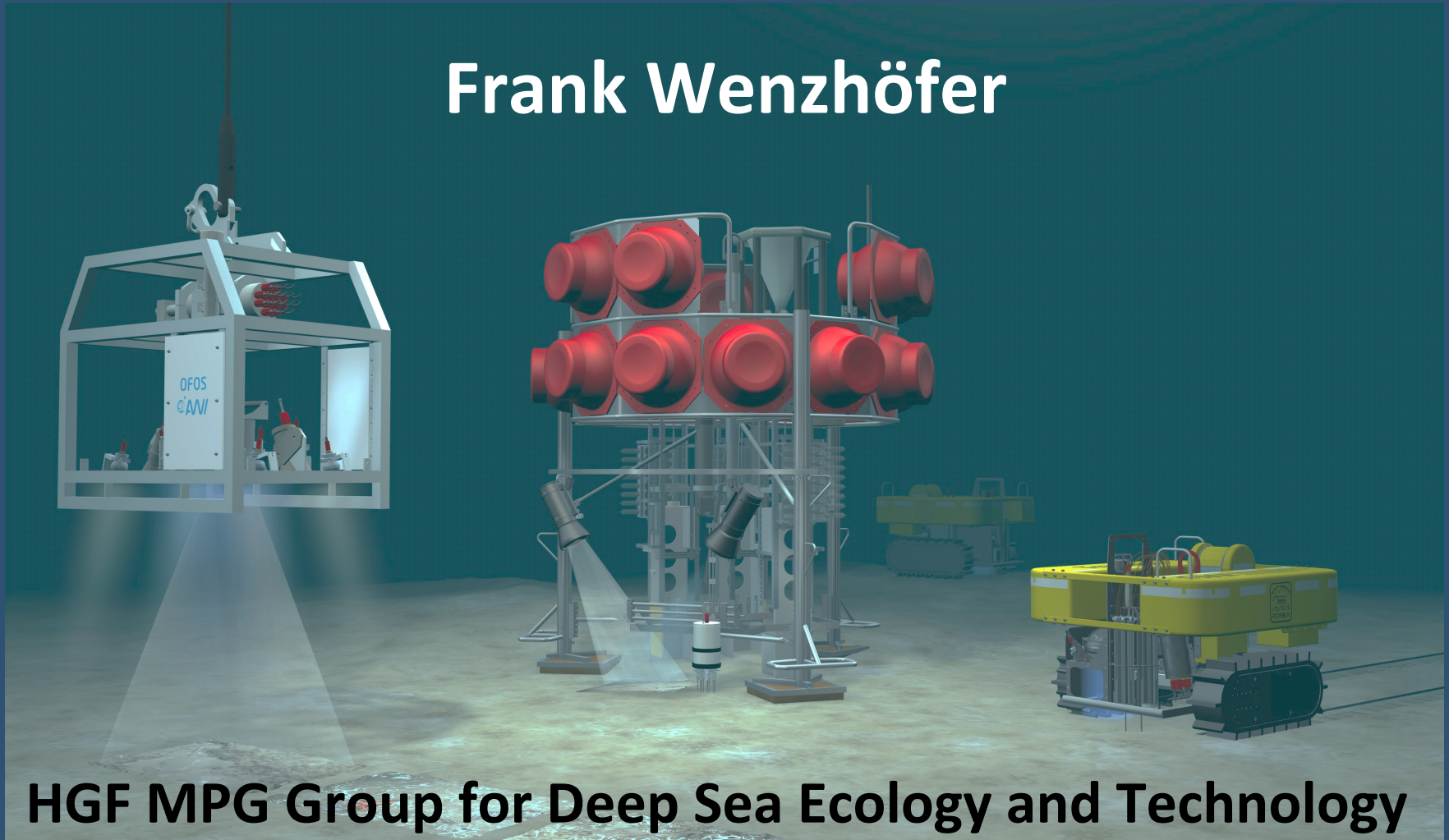


Platforms for biogeochemical measurements

Frank Wenzhöfer



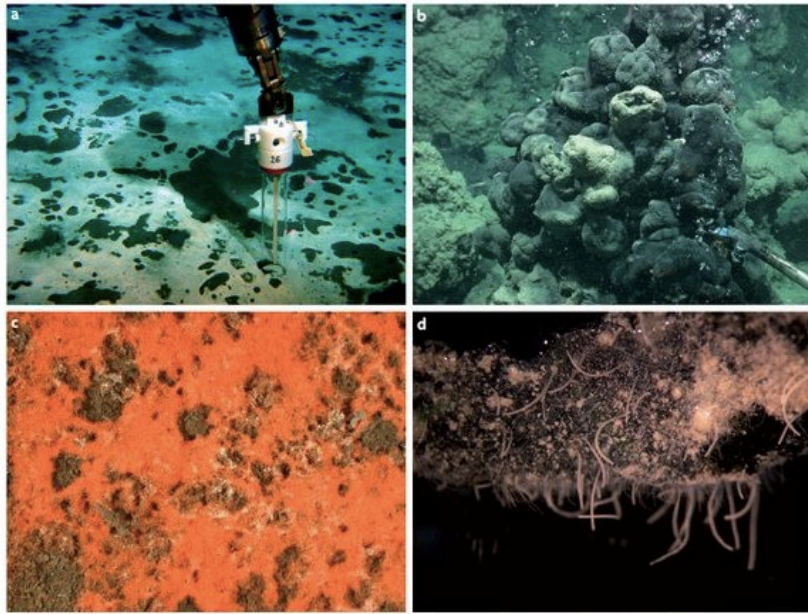
HGF MPG Group for Deep Sea Ecology and Technology

Max Planck Institute for Marine Microbiology, Bremen

Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Bremerhaven

frank.wenzhoefer@awi.de

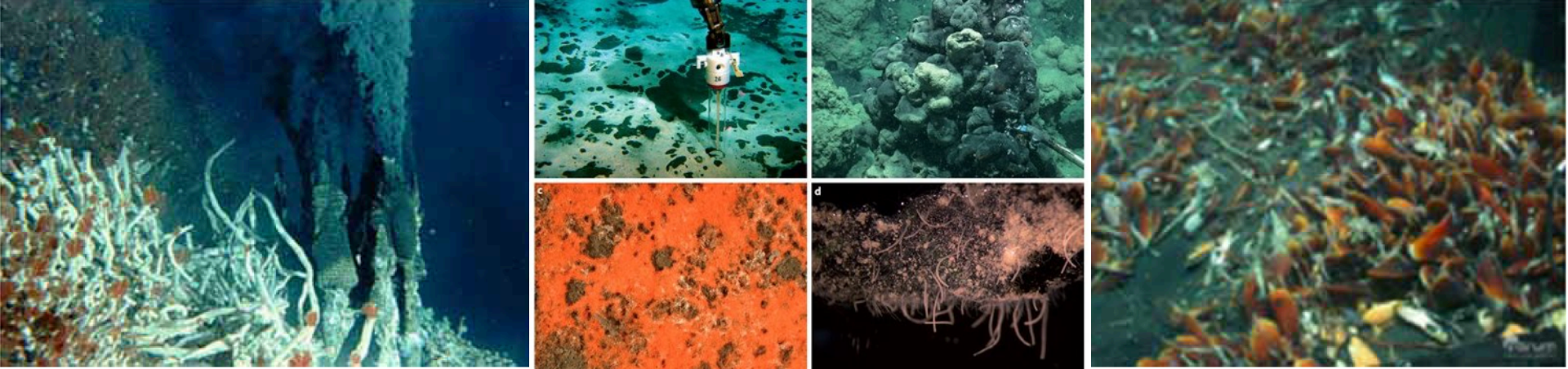
Biogeochemical processes



- distribution and limits of life in the geosphere (Earth and other celestial bodies)
- how processes involving microbes, organic and inorganic matter shape the geochemistry and mineralogy of Earth's surface

Future trends in geomicrobiology:

- which geo-microbes are (have been, will be) doing what, when, why, and how
- quantification of geomicrobial processes and their global relevance across all scales of space and time

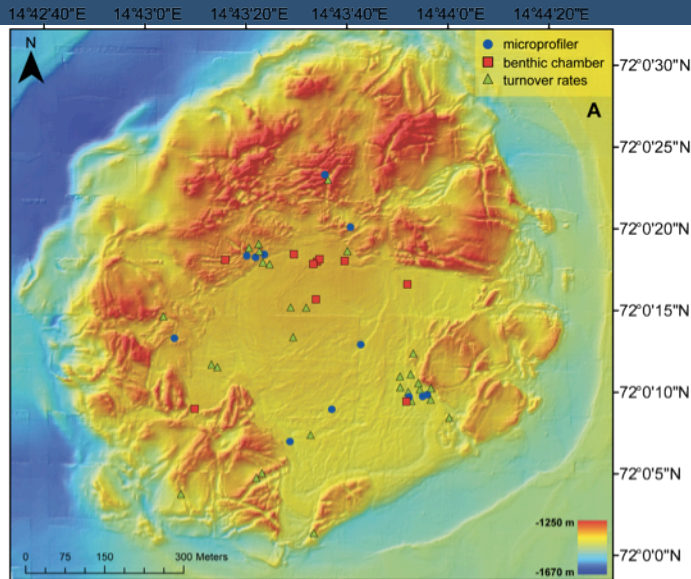


„Spatial patterns in the distribution of microorganisms“ -
Recognizing spatial patterns helps understanding processes

Linking benthic fluxes and ecology of the seafloor

- **Role of the seafloor in element cycles**
- **Geosphere-biosphere coupling**
- **Ecosystem function: understanding the links between environment, the community and its activity**

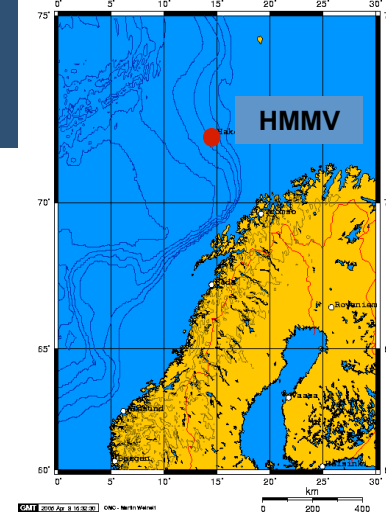
Geostructure - Cold seeps in the Nordic Sea



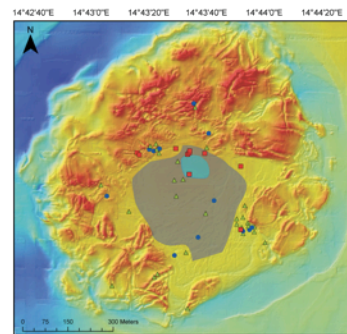
Håkon Mosby mud volcano (HMMV)

Water depth 1250 m

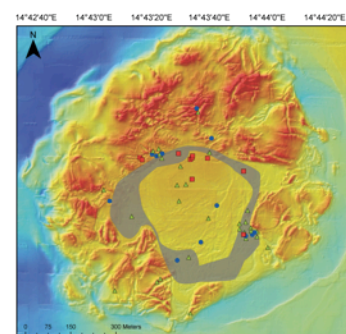
Size: > Ø 1 km, 10 m high



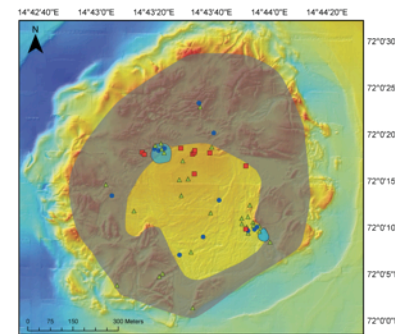
center (I)



Beggiatoa mat (II)

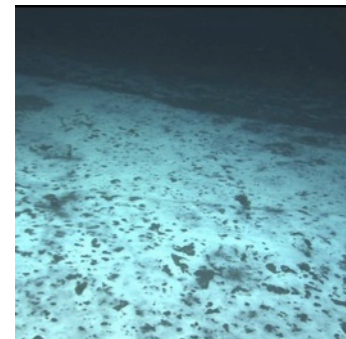
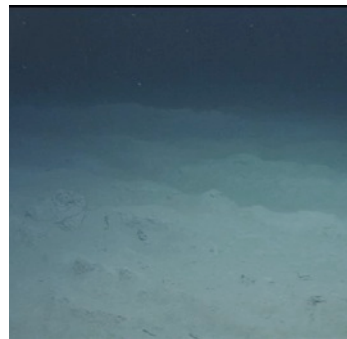


gray mats (III) & Siboglinid tubeworms (IV)

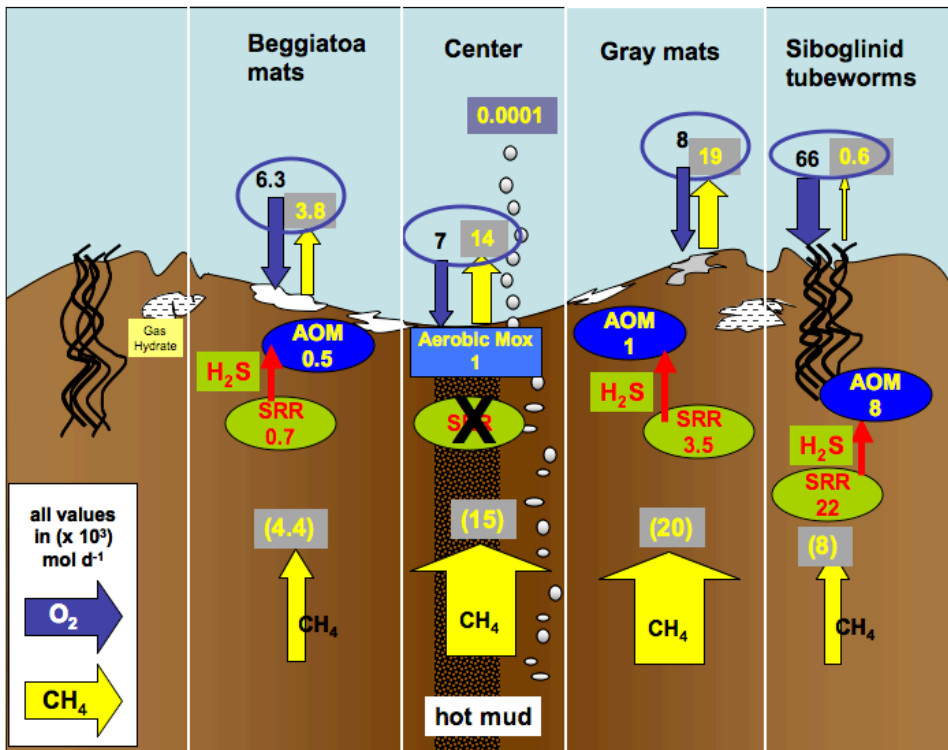


Video **observation** (ROV)
and high-resolution
bathymetry maps (AUV)

➡ **define habitat** areas

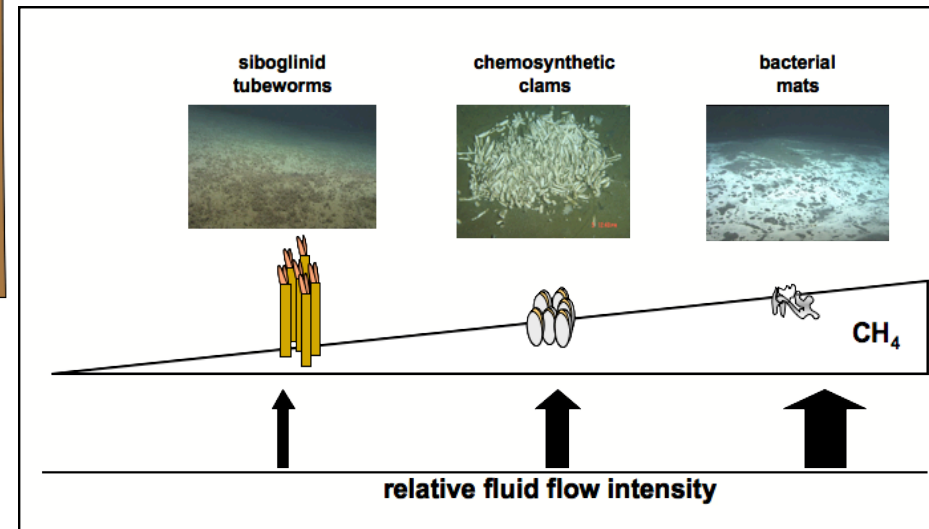


Geostructure – biogeochemical processes



Efficiency of the biological filter:

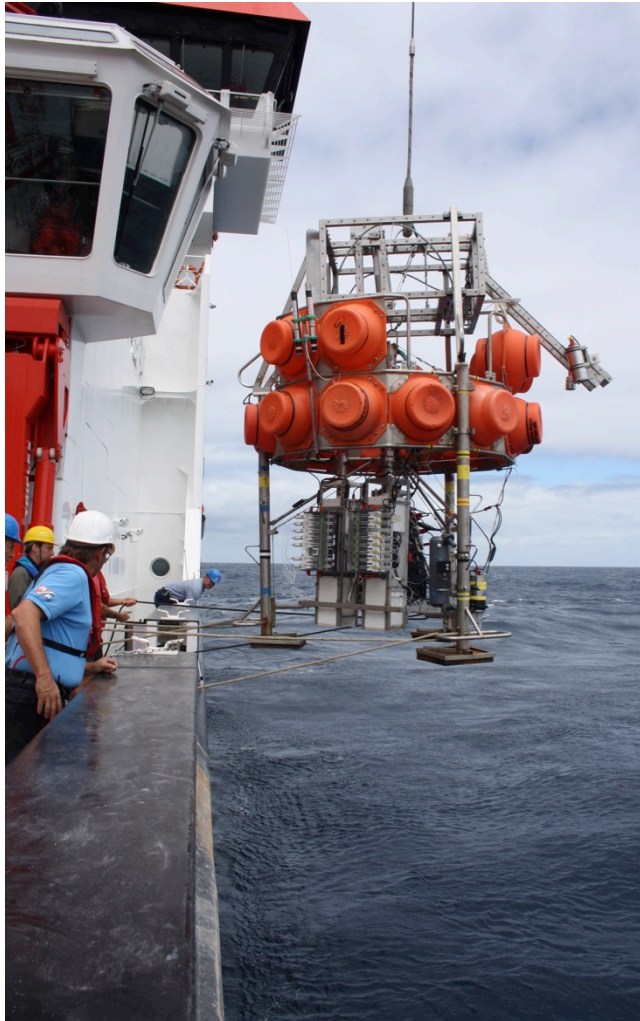
Center	< 10%
Begg. Mats	12%
Gray mats	30%
Siboglinid tubeworms	> 90%



For the entire geostructure 22-55% of the dissolved CH_4 is removed

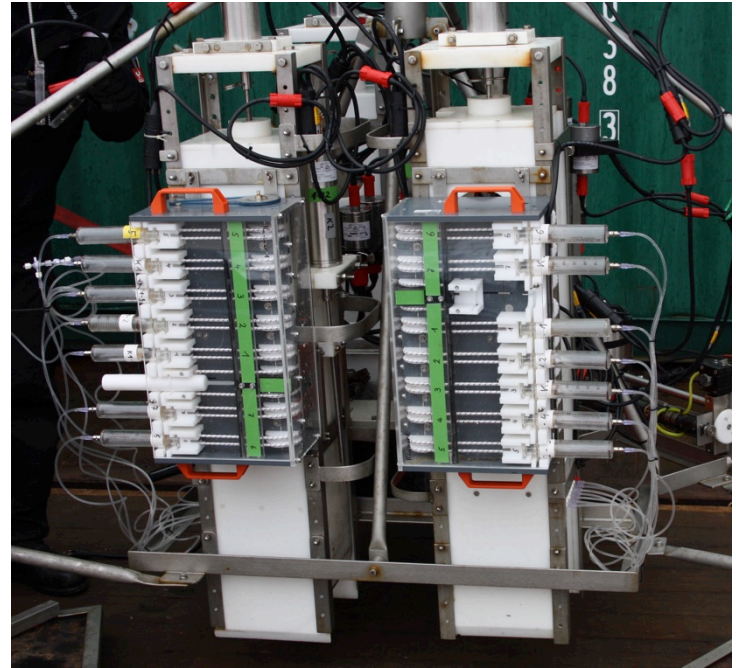
This is only 10-15% of the total CH_4 flux (including the emission of free gas)

Freefalling Benthic Lander Systems

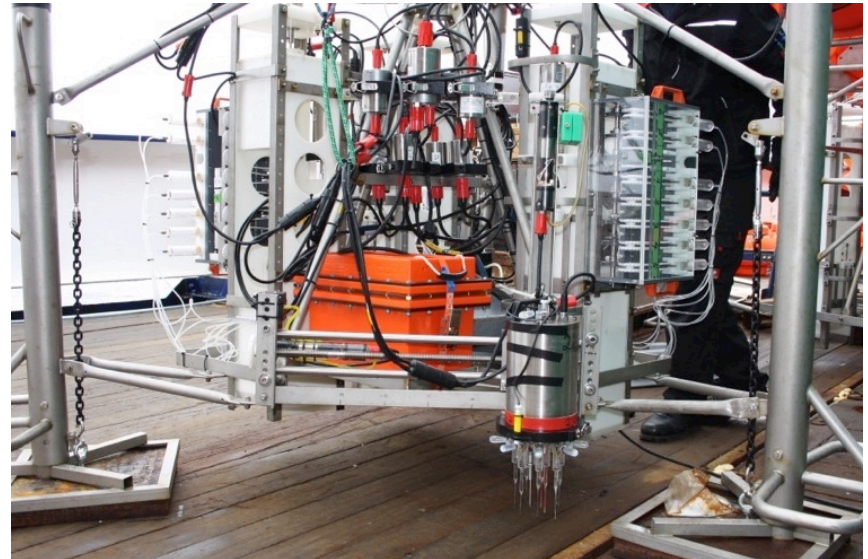


Freefalling Benthic Lander Systems

Chamber

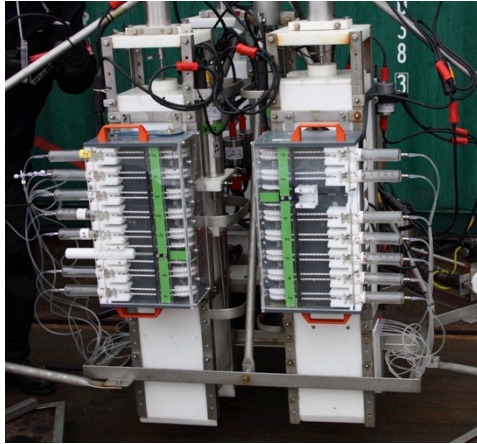


Profiler

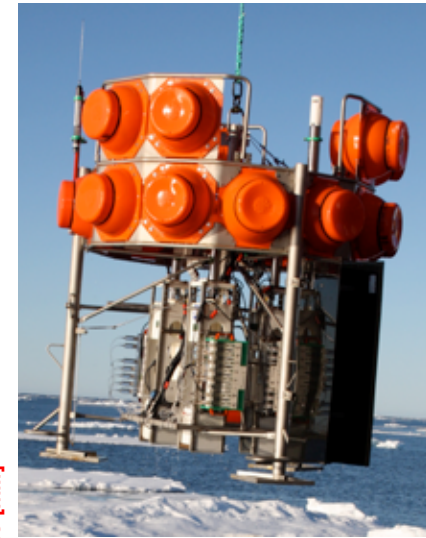
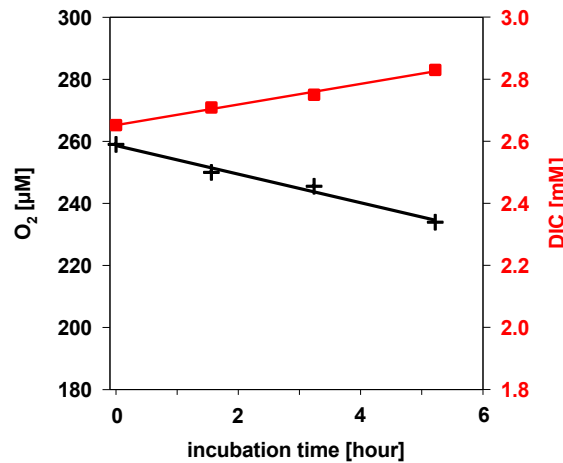


Freefalling Benthic Lander Systems

Chamber

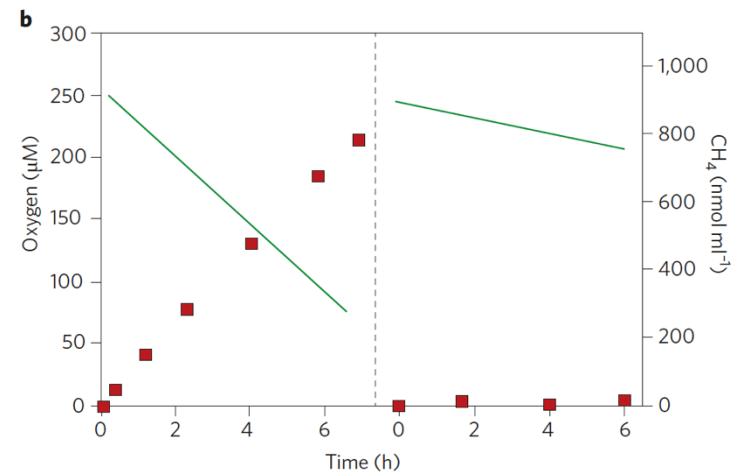


➤ sensors
(O_2 , H_2S , pH)



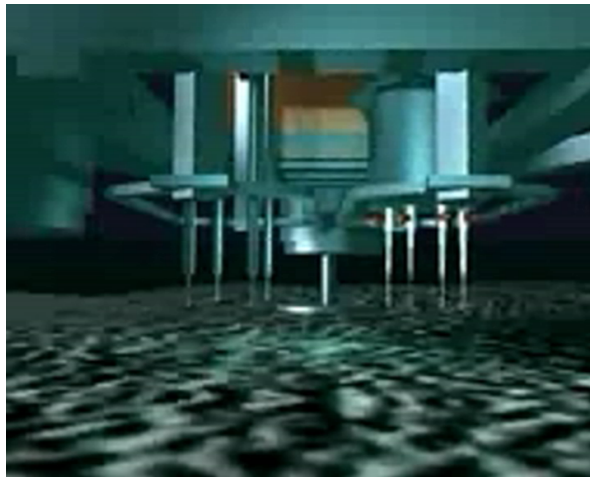
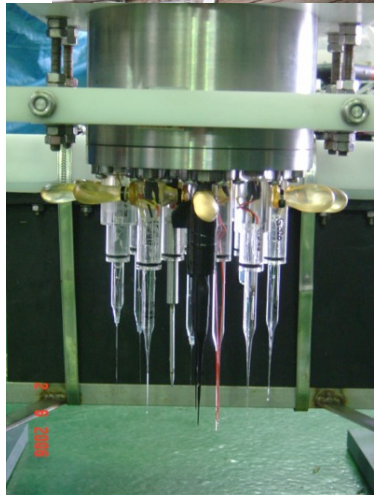
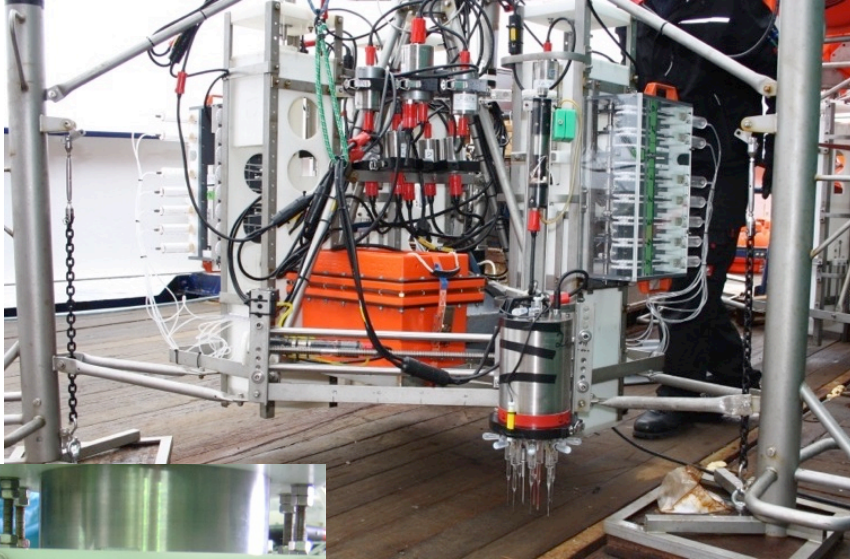
➤ Syringes for water samples at preprogrammed time points for:

- DIC (dissolved inorganic carbon)
- H_2S
- Nutrients
- hydrocarbons
- oxygen



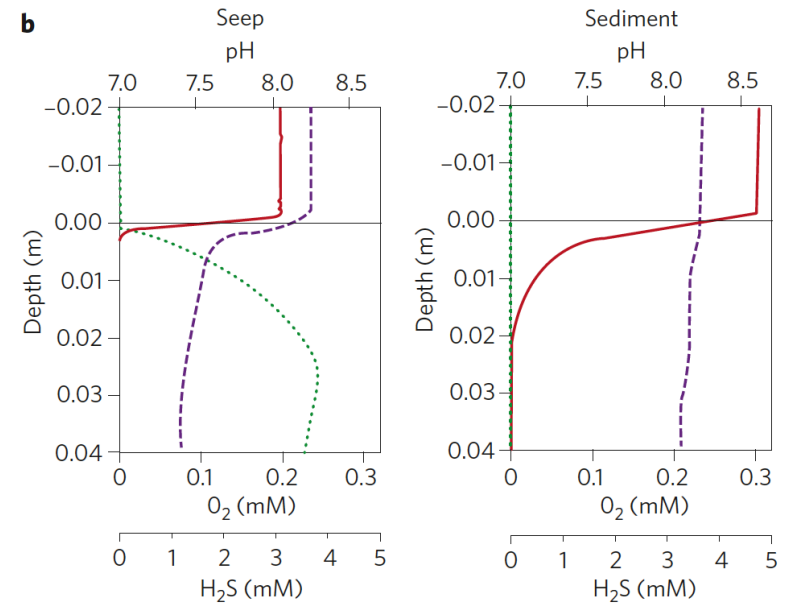
Freefalling Benthic Lander Systems

XY-Profiler



Sensors:

- Oxygen
- H_2S
- pH
- Temperature
- Redox
- Resistivity
- pCO_2
- Ca^{2+}
- N_2O
- NO_3^-



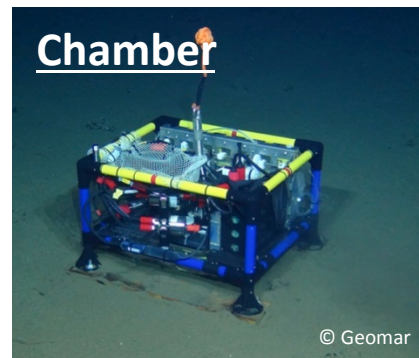
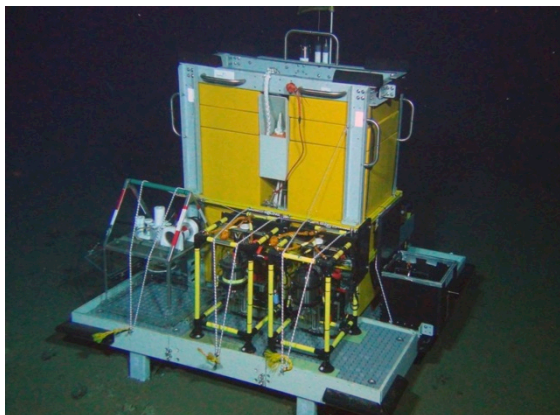
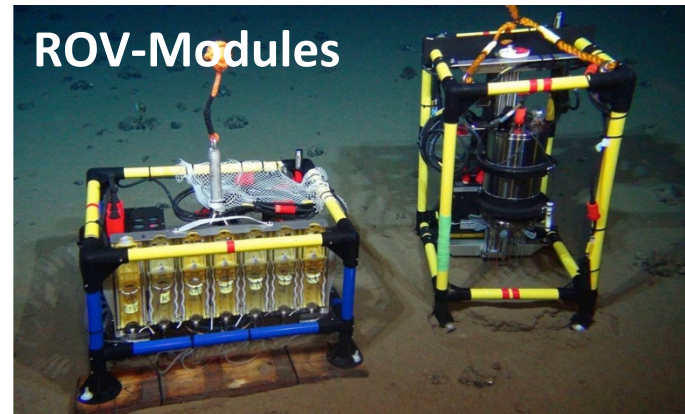
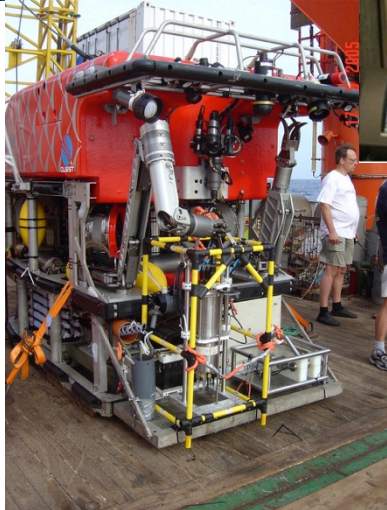
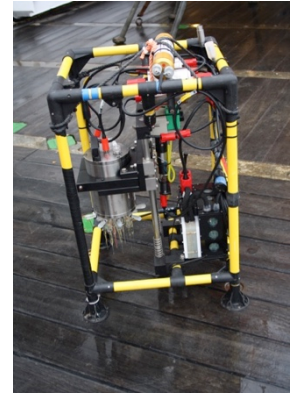
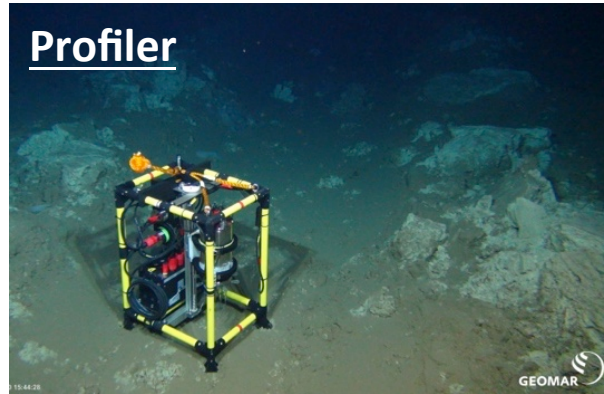
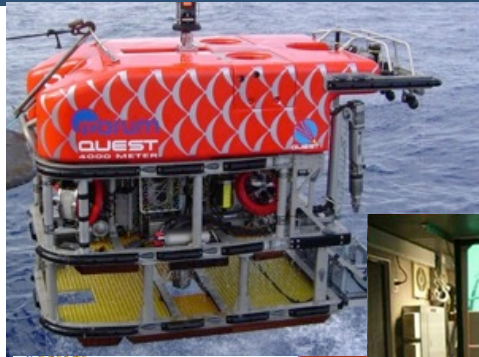
ROV-operated instruments

ROV Quest
Marum, Germany

Profiler

ROV-Modules

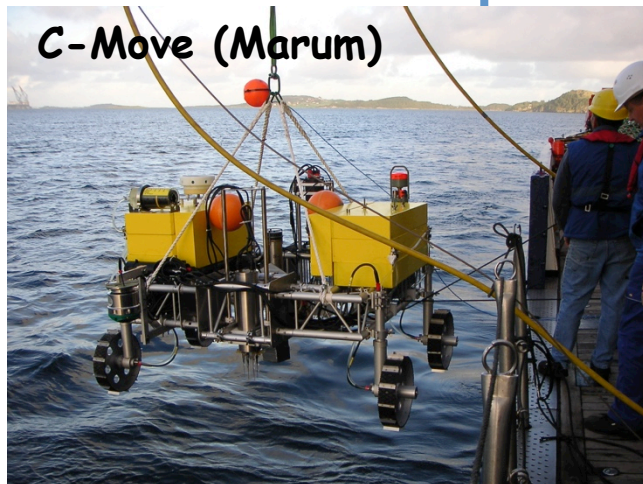
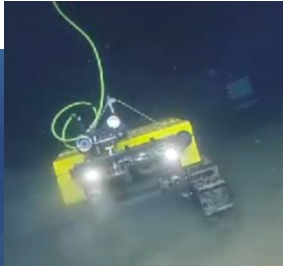
Chamber



Mobile Benthic Systems - Crawler

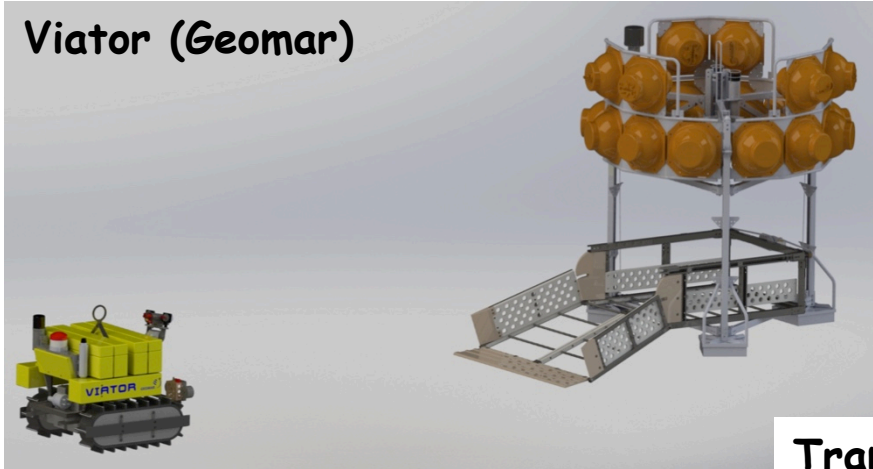
Cabled Crawler

Wally (JUB)

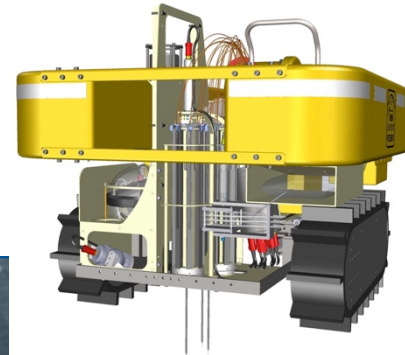


Autonomous Crawler

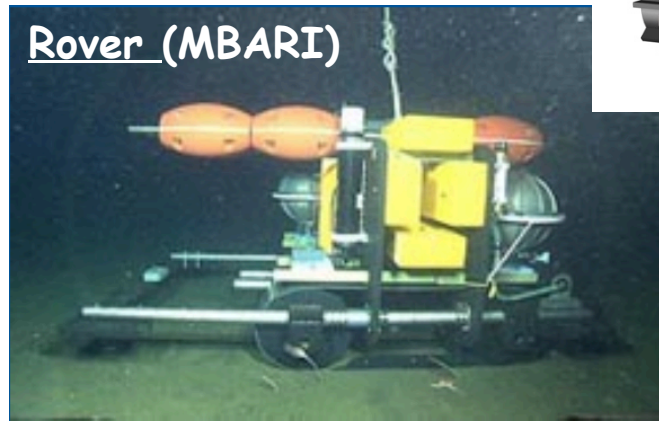
Viator (Geomar)



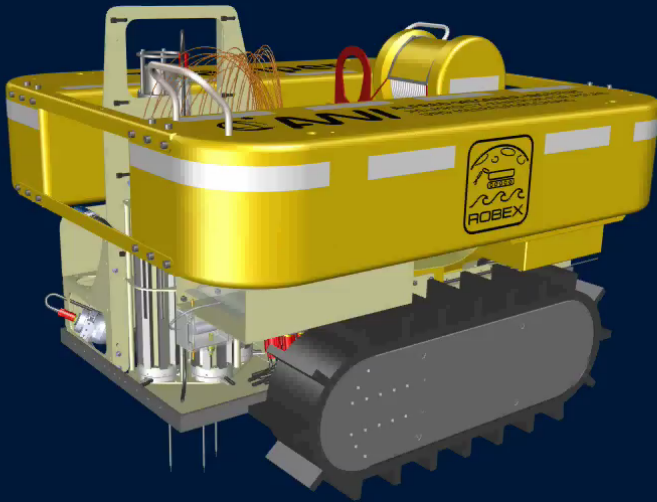
Tramper (AWI)



Rover (MBARI)



➤ Autonomous long-term deep sea crawler for biogeochemical studies



Specification

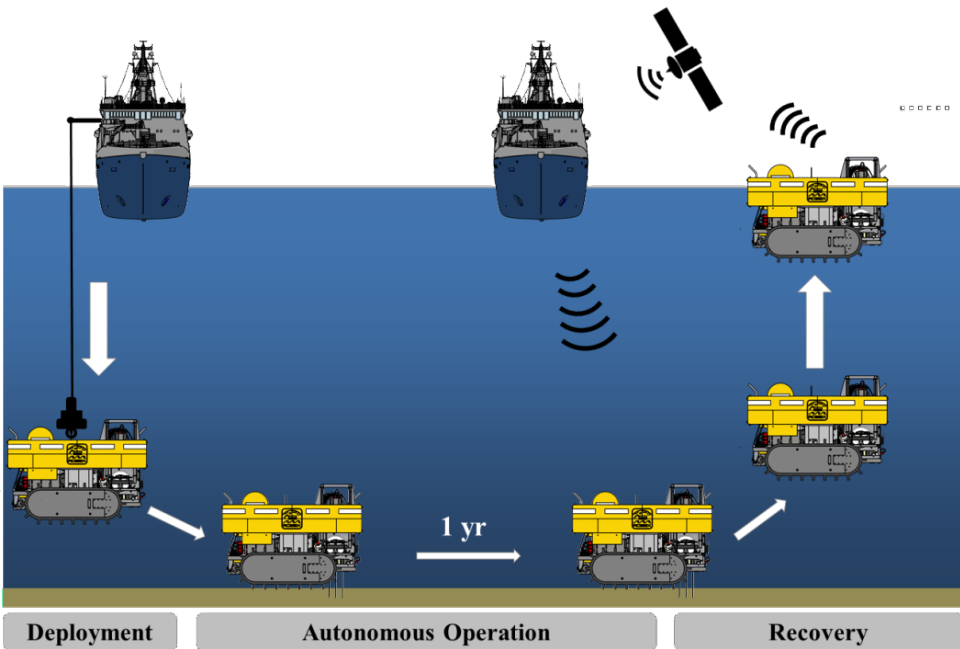
- Depth Rating 6000m
- Length 1.5m; width 1.26m; height 1.12m
- Dry weight 653kg
- Weight in water 20kg (without ballast -40kg)
- Max. speed 13 m/min (operation speed 3 m/min)
- Battery 32.4V, 5.7kWh

Scientific Payload

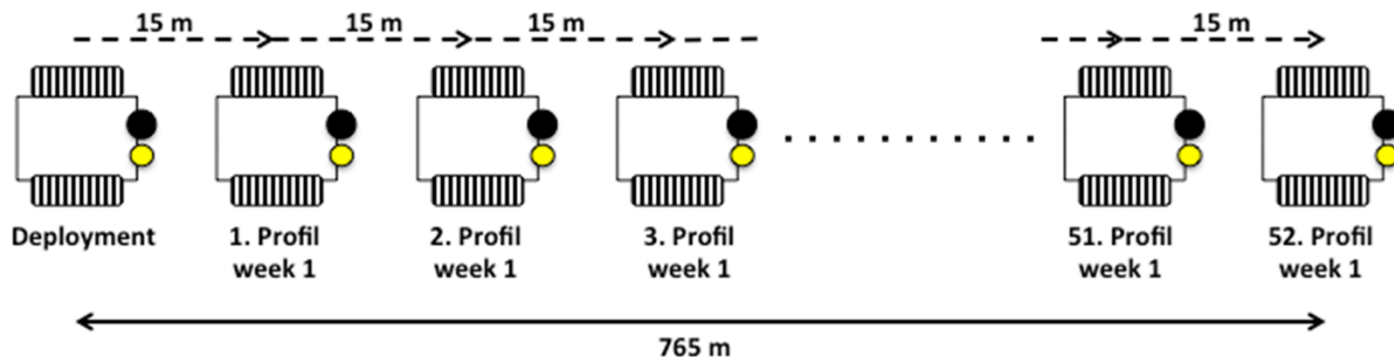
- Profiler with 18 O₂-sensors
- High resolution DSLR camera (Nikon D300S)
- LED-Light (DeepSea Power & Light Sphere)

TRAMPER

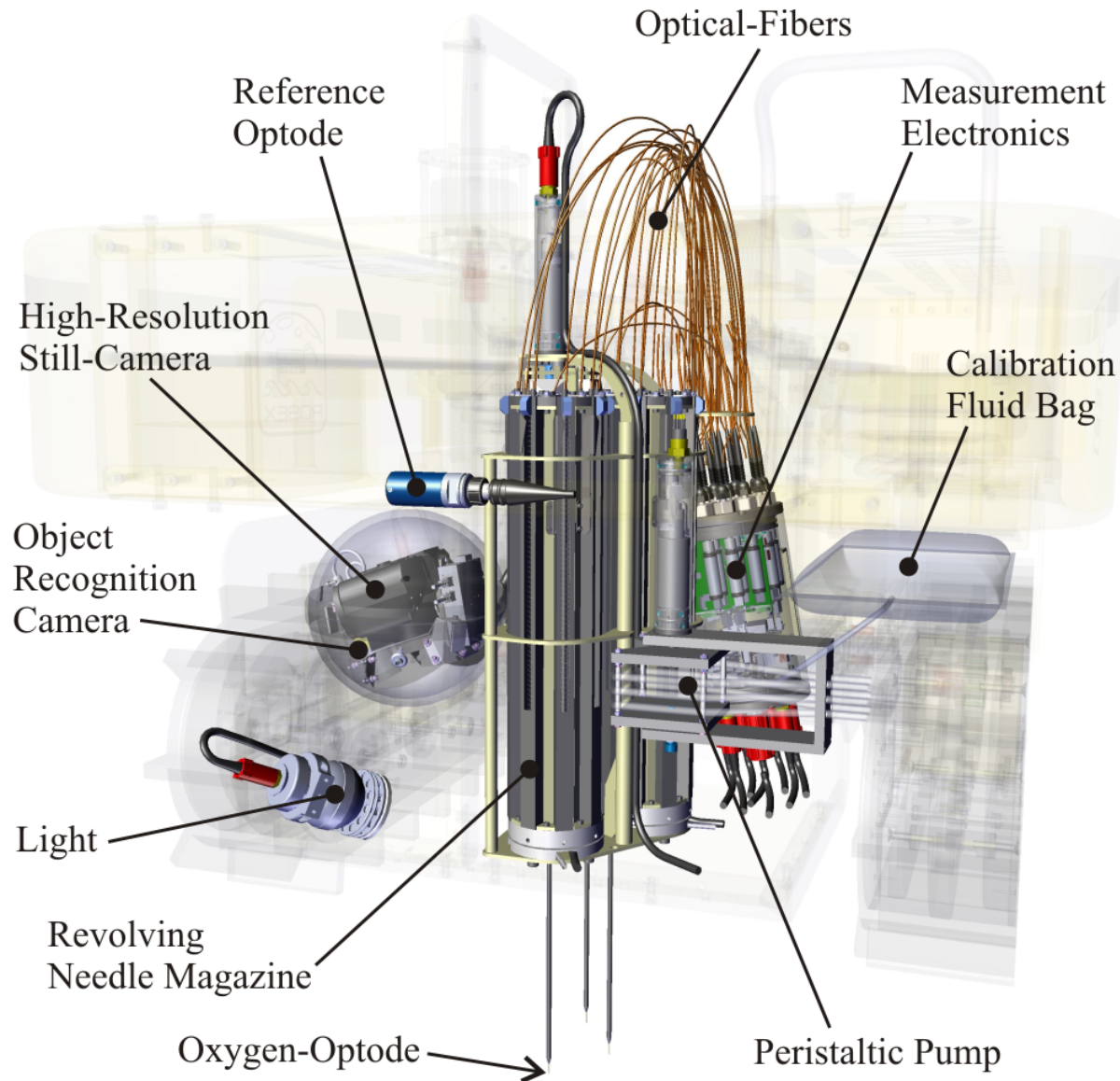
1st Long-term mission deployment



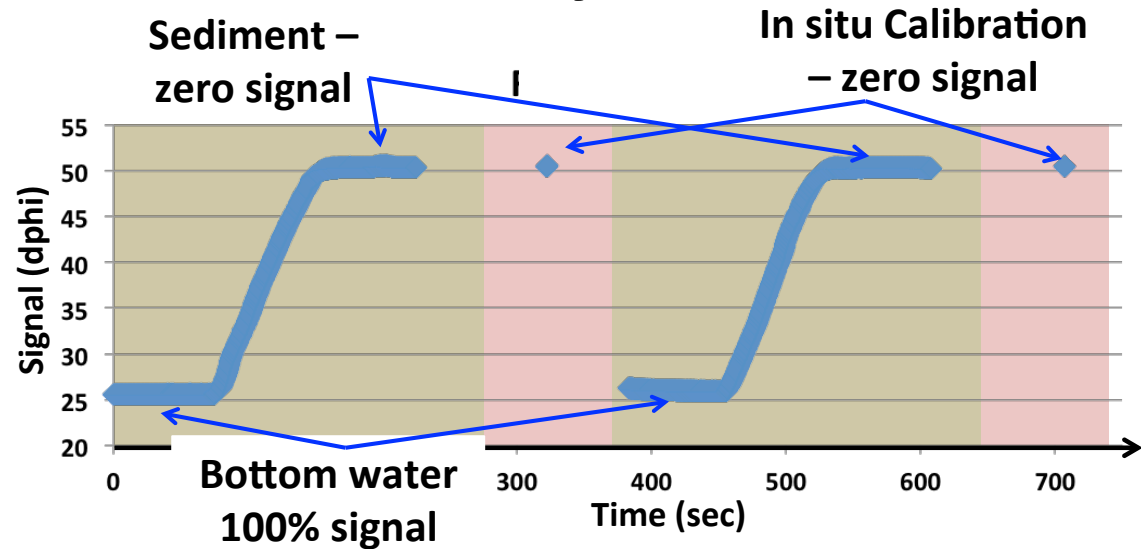
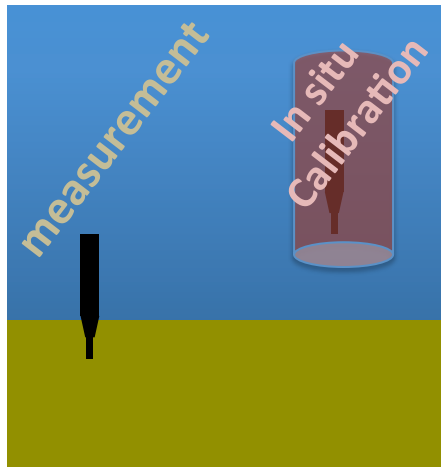
- 1-year deployment
- > 52 measurements (once per week)
- 3 Sensors per measurement
- Photo of the sampling site
- Movement before measurement ca 15m
- Change of sensors every 8-12 weeks; calibration after 4 measurements



TRAMPER - Scientific payload



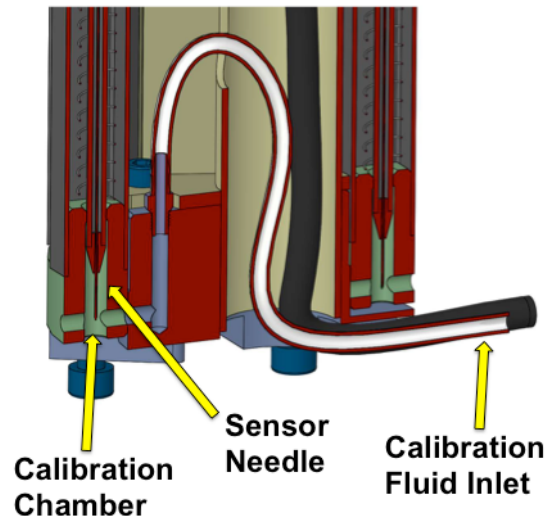
Measurement and calibration cycle



Measurement



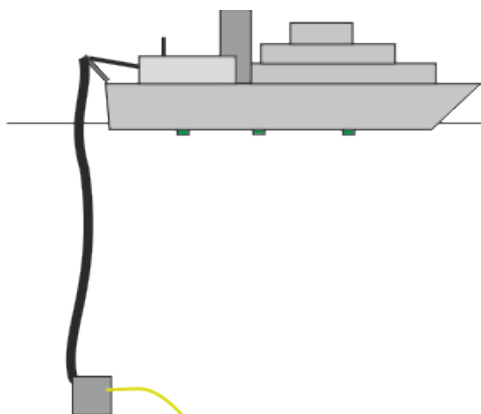
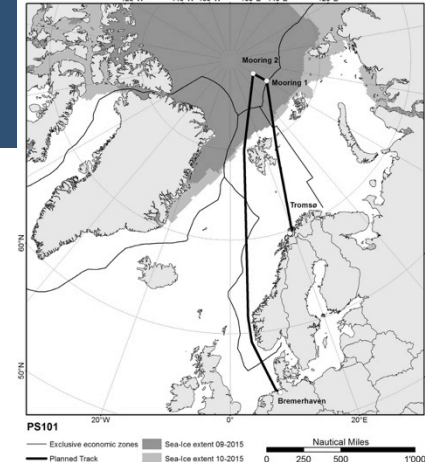
In situ Calibration





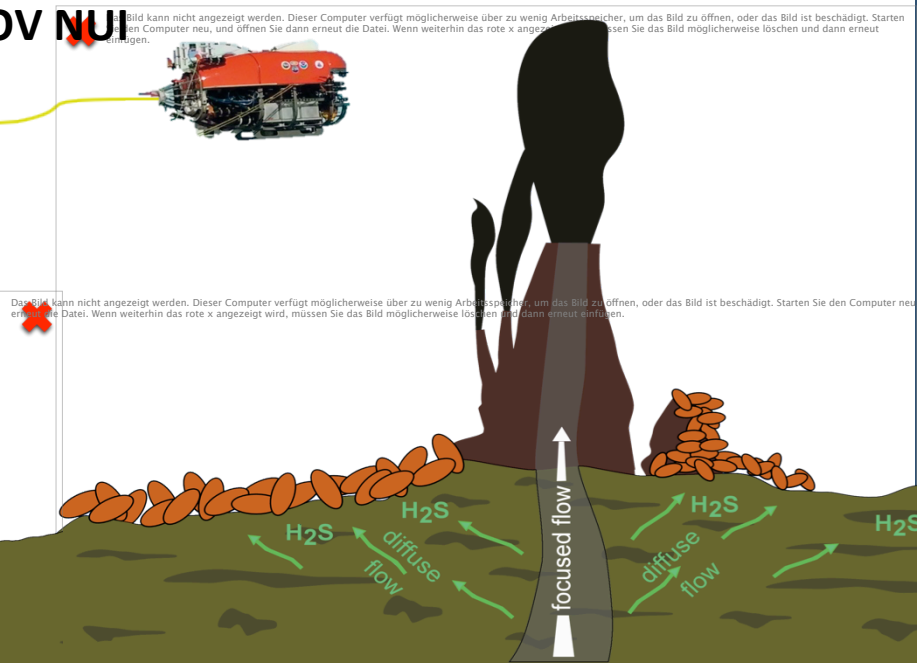
Mission Scenario

PS 101 2016 (Karasik Seamount – Hydrothermal vents)



WHOI HROV NUI

Identify physico-chemical and biosignatures generated by hydrothermal plumes and chemosynthetic ecosystems



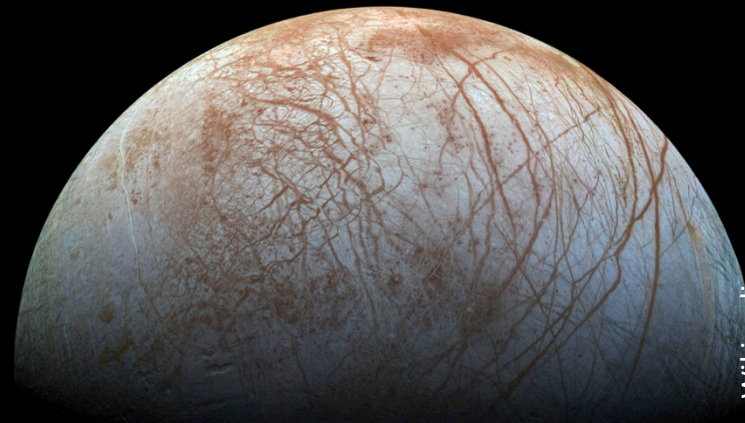
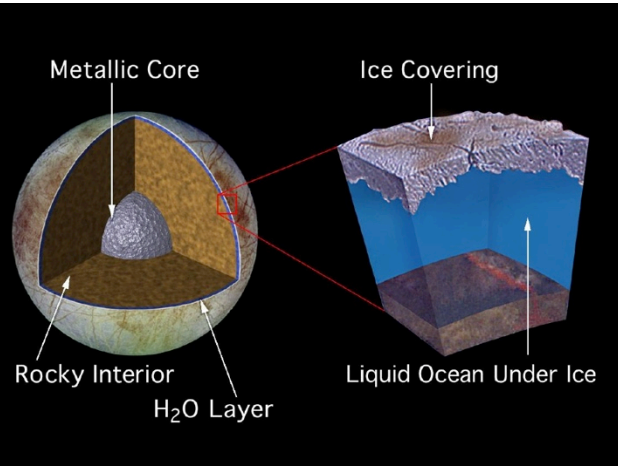
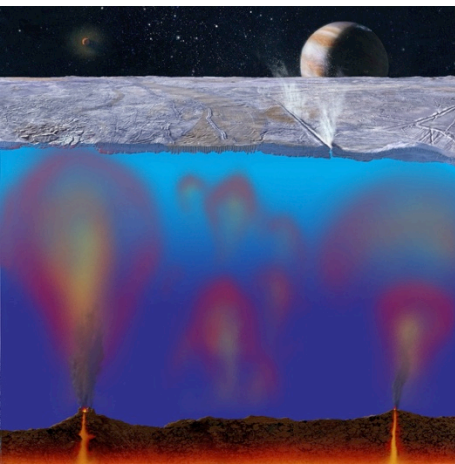
Mission Scenario



Investigate the fate of biosignatures as they are released upward in hydrothermal plumes into the water column and/or the overlying ice-cover (NASA funded project; WHOI)

Expedition Programme PS108

Europa: An Ocean under the ice



Wikipedia

HGF Alliance ROBEX - Demonstration Mission



Foto: S. Arndt

RV Polarstern PS 108

Duration: 19 days

22.08. – 09.09.2017

Tromsø – Tromsø



Mansio-Viator



Tramper



Glider



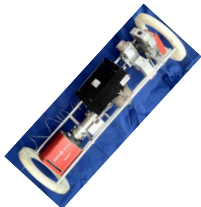
UAV's



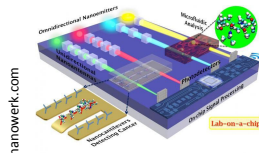
O₂-Microprofiler



Underwater-MassSpec



Lab-On-Chip (LOC)



Camera systems



THANK YOU

FRAM



ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Max Planck Institute
for Marine Microbiology



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Benthic in situ experiments