SO210 (CHIFLUX)

Peter Linke for the cruise proponents

IFM-GEOMAR

SUBDUCTION
SFB 574
Fluids-Volatiles-Hazards

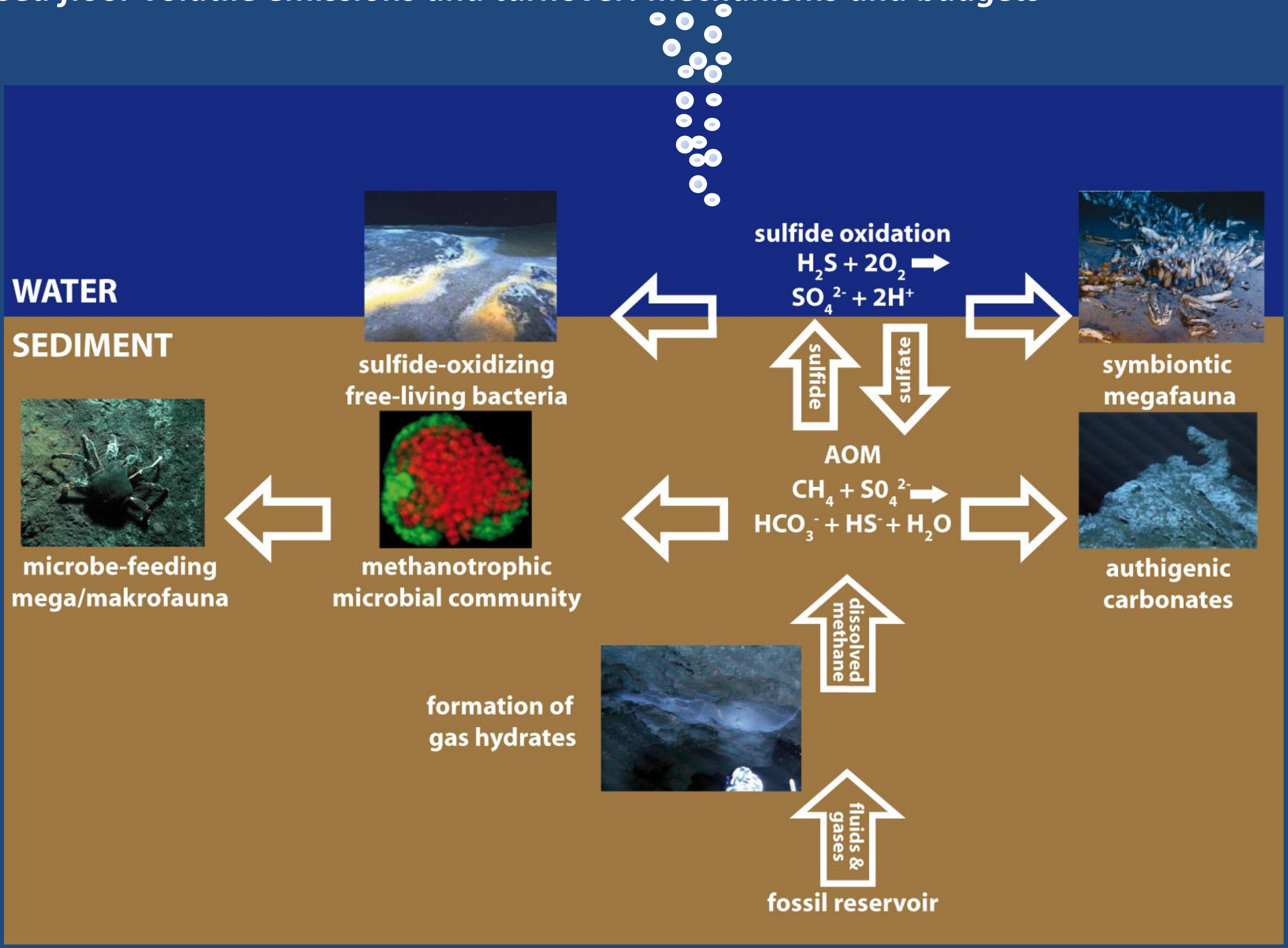
- Aims of the subprojects (A1,B3,B5,B6,C4)
- Methods
- Working area & Present knowledge
- Logistics

SP-A1 *Re-evaluation and dating of marine landslides*

- Identification and mapping of features indicating fluid venting (mud volcanoes, vents, mounds) landward of the headscarps to look for spatial relations between those and the landslides (Swath bathymetry and backscatter).
- Dating of the individual structures to evaluate possible correlations with climate change and tectonic events. Sediment echosounder profiles will be run across the run-out zone of individual slumps to determine the overlying and underlying units. Debris flows at the toe of submarine slumps should have a defined (acoustically transparent) seismic signature which is fairly different from those of layered hemipelagic sediments deposited after the event. Sampling by gravity coring and dating of the uppermost sediments overlain by the landslide run-out and the lowermost pelagic sediments deposited on the run-out will bracket the age of the landslide. Dating will be carried out on samples from a few locations and extrapolated using Parasound data.
- Coring the detachment plane just above the displaced sediment mass, respectively at the foot of the headscarp. Coring at this particular location provides material to be tested for its mechanical properties and mineralogical composition. This layer has to reveal properties which make it prone to failure. Of particular interest is the role of ash layers in triggering submarine slumping.

SP-B3 ***Sea floor volatile emissions and turnover: mechanisms and budgets***

- in-situ data of the complex physico-chemical controlling mechanisms on the effective discharge rates of fluids and dissolved chemical species
- volatile seafloor emission rates
- pore-water gradients
- microbial activity in the sediments and in the water column.



SP-B5 *Diagenetic processes in fore-arc sediments and volatile input to subduction zone systems*

Overall, B5 will work on sediment cores from active dewatering sites and incoming plate sediments in order to:

- characterise the composition of emanating fluids and determine key processes that drive fluid mobilization and chemical alteration at depth,
- quantify diagenetic turnover rates in surface sediments along the slope, and
- provide chemical compositions and volatile concentrations of subduction zone input.

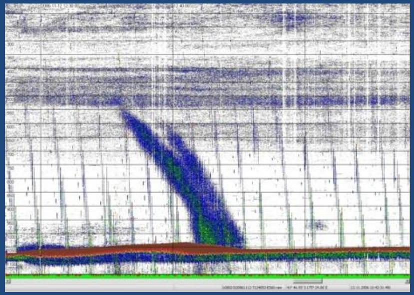
SP-B6 *Cold seep associated carbonates as long-term high resolution archive of fluid flux*

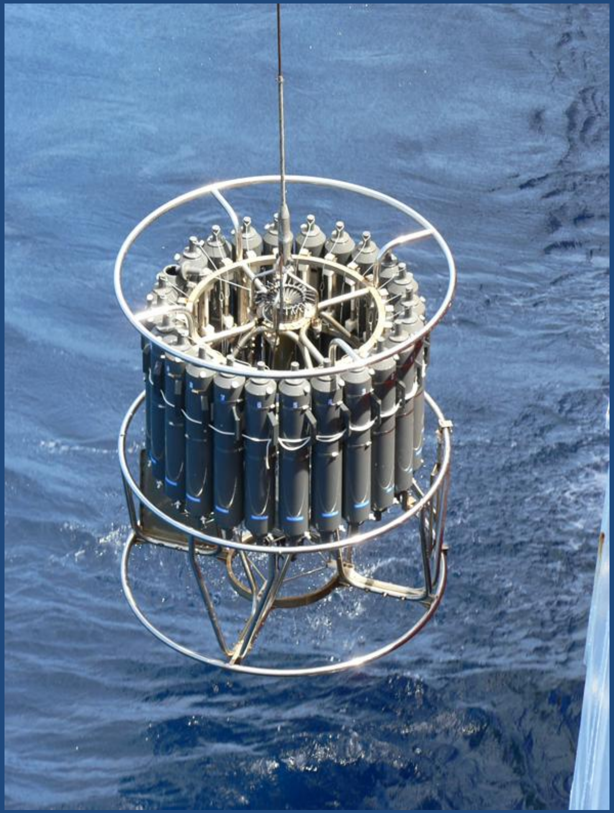
- Recovery of large carbonate samples from different cold vent sites in order to investigate the successive long-term precipitaiton of authigenic carbonates (TVG).
- Recovery of inter-sedimentary authigenic carbonates from gas hydrate bearing sediments to investigate the link between carbonate precipitation, pore water chemistry and gas hydrate turnover (TVG, MUC, GC).
- Combined in-situ sampling of emanating fluid and related precipitates for determination of chemical fluxes and isotope signatures (ROV, BIGO)
- Sampling of depth resolved bottom water profiles on or close to the vent sites for determination of geochemical and isotopic signatures at the sediment/water-interface in order to define typical initial isotopic signatures (e.g. U and Th) for authigenic carbonates (ROV).
- Sampling of selected water column profiles for U-series radiochemistry and geochemical background signatures (CTD)

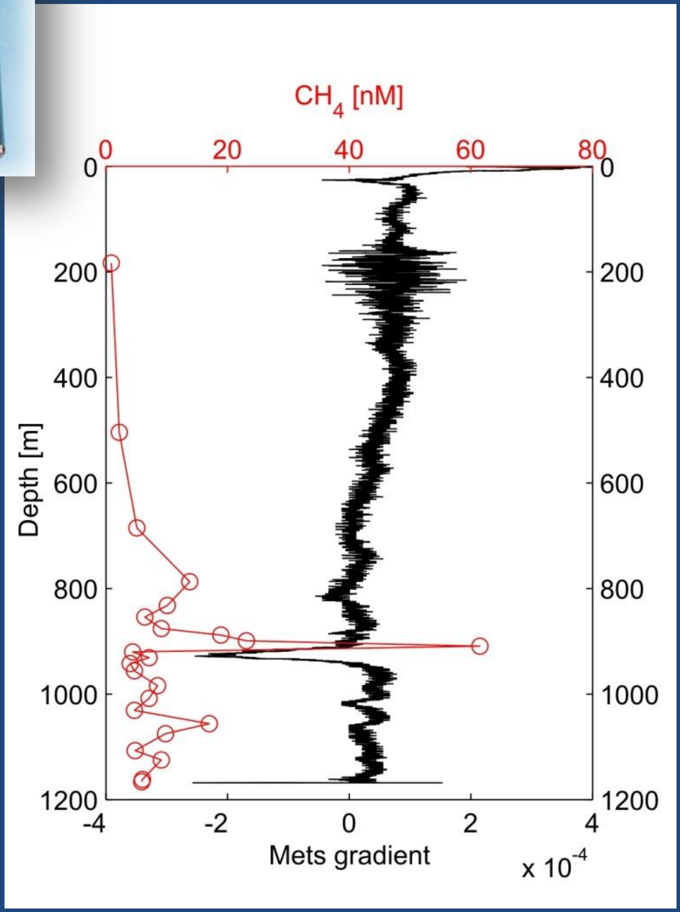
SP-C4 *Tephra stratigraphy*

Gravity coring for the proposed tephrostratigraphic work serves a triple purpose:

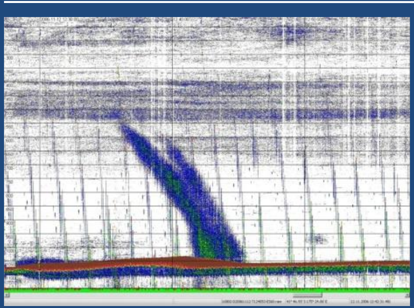
- to identify the westward dispersal of volcanic ash erupted from volcanoes of the Southern Volcanic Zone (SVZ) in central Chile, determine the source volcanoes of marine ash beds via chemical compositions, and establish their stratigraphic succession and volumes;
- to use ash layers as marker horizons for correlating sediment cores and allowing for relative (and possibly absolute) dating of intercalated sediments, particularly sediments derived from mound activity (SP-B5, SP-B6) or landslide detachment (SP-A1);
- to determine the contribution of volcanic ash to the total sediment composition to constrain better the composition of the subduction input.



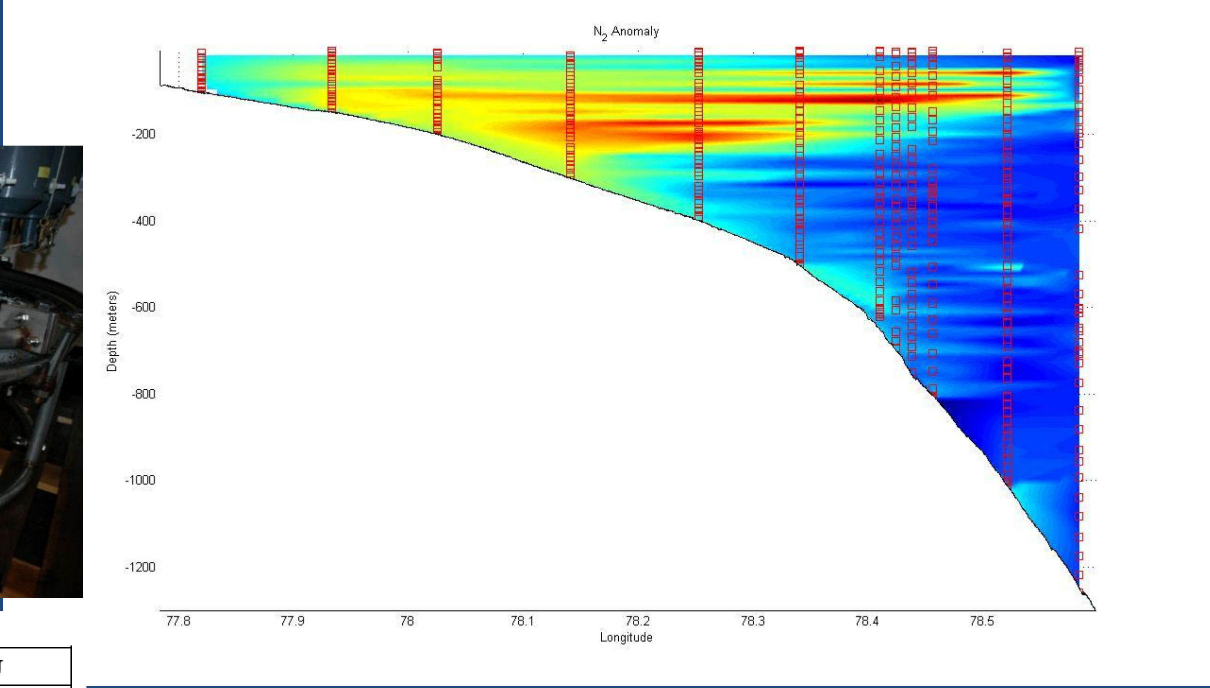




Faure et al. , 2010



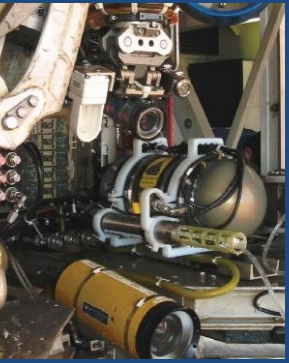
TETHYS (TETHered Yearlong Spectrometer)



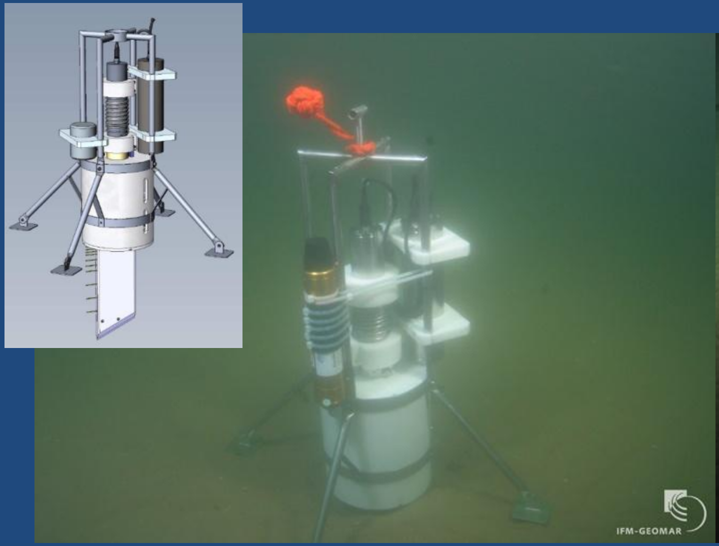
TETHYS OPERATIONAL CHARACTERISTICS

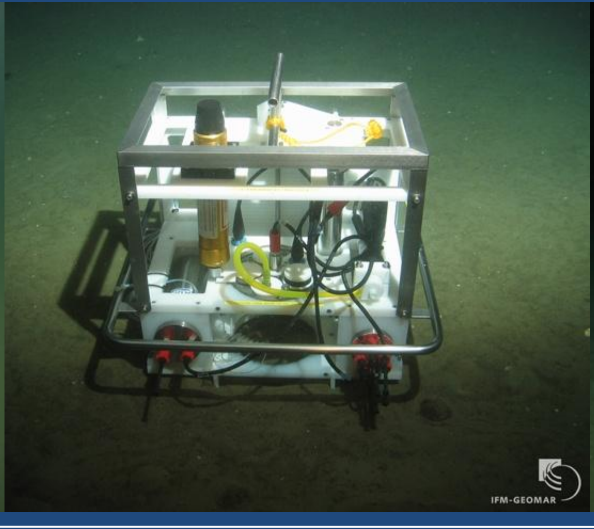
Mass range	1-200 AMU
Mass resolution	<0.1AMU
Power	25 Watts @ 24V
Maximum depth	5,000 meters
Endurance	~1 year
Response time	5 seconds
Sensitivity (LOD)	~1 ppb
External dimensions (with 5,000m housing)	23cm OD x 61cm
Weight in water (with 5,000m housing)	13 kg
Moving parts	none

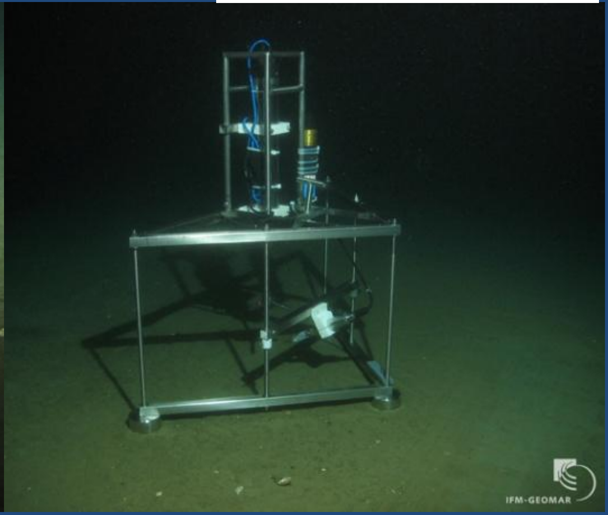
$(N_2/Ar)_{sat}$ distribution in the water column across the continental margin of Peru at 11° S; $(N_2/Ar)_{sat} = (N_2/Ar)_{molar\ ratio} / (N_2/Ar)_{saturation\ equilibrium\ ratio}$. Red squares denote measurement locations. Preliminary data by Rich Camilli (WHOI)

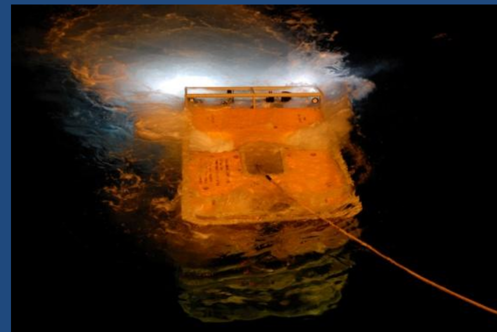


- Upward-looking ADCP & CTD (deployed by lander)
- Eddy correlation technique (deployed by ROV)
- In situ mass spectrometer (mounted on ROV)
- Microprofiler (deployed by lander)
- Benthic chambers (deployed by ROV)
- Pore water sampler (deployed by ROV)
- Push cores (deployed by ROV)
- Lift system (under development)

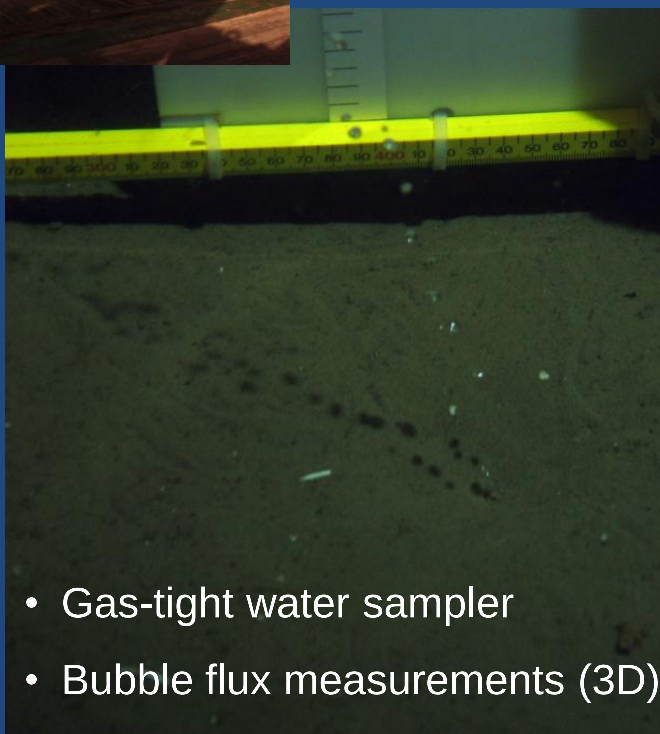


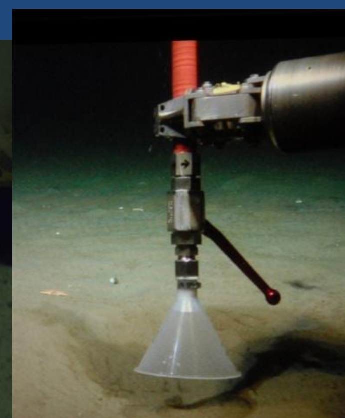




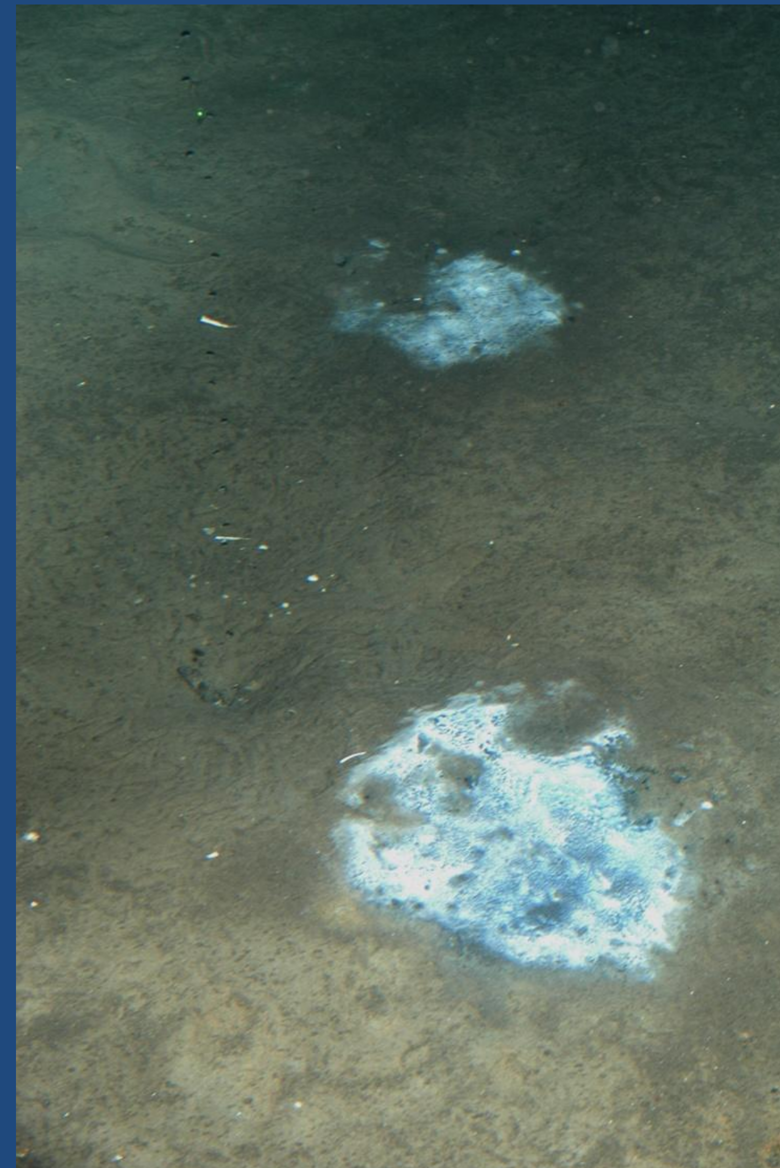


ROV „Kiel 6000“





- Gas-tight water sampler
- Bubble flux measurements (3D)

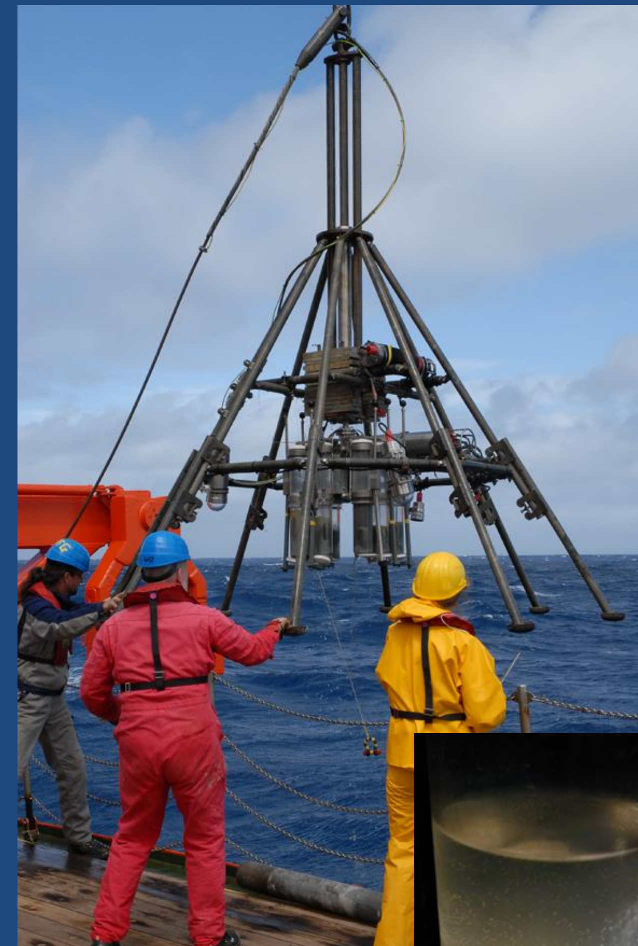


Methods: Ground-truthing by video-guided & conventional sampling

TV grab

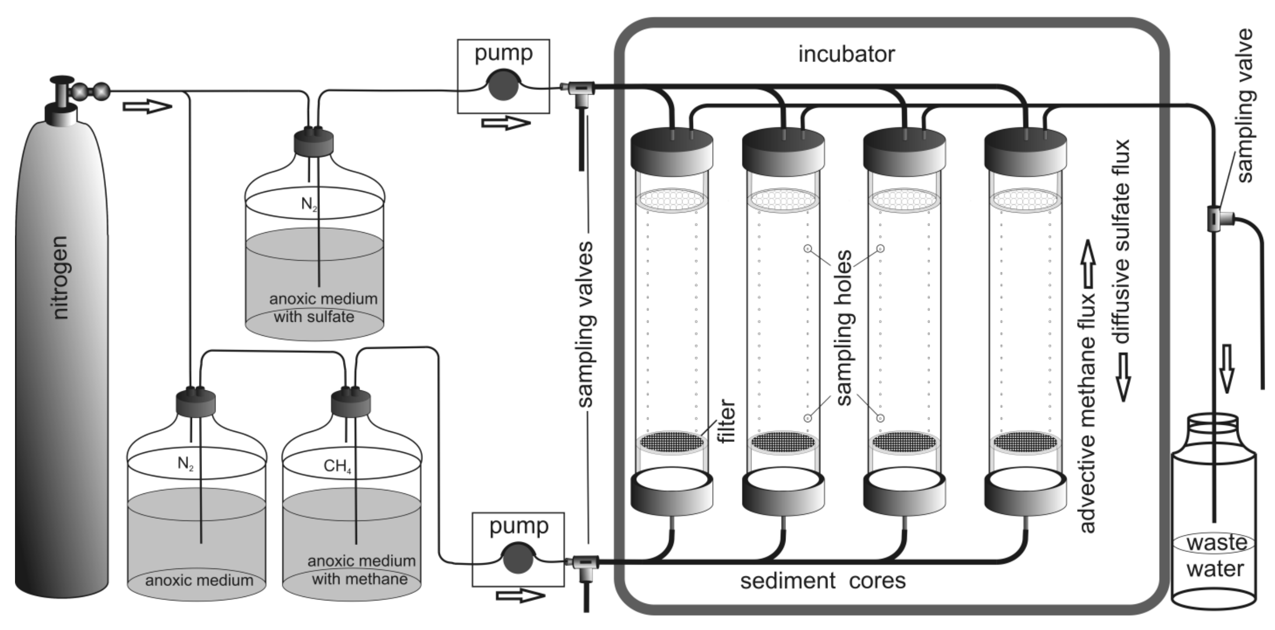
Liebetrau et al. ,
Mar. Geol., 2010

Gravity corer



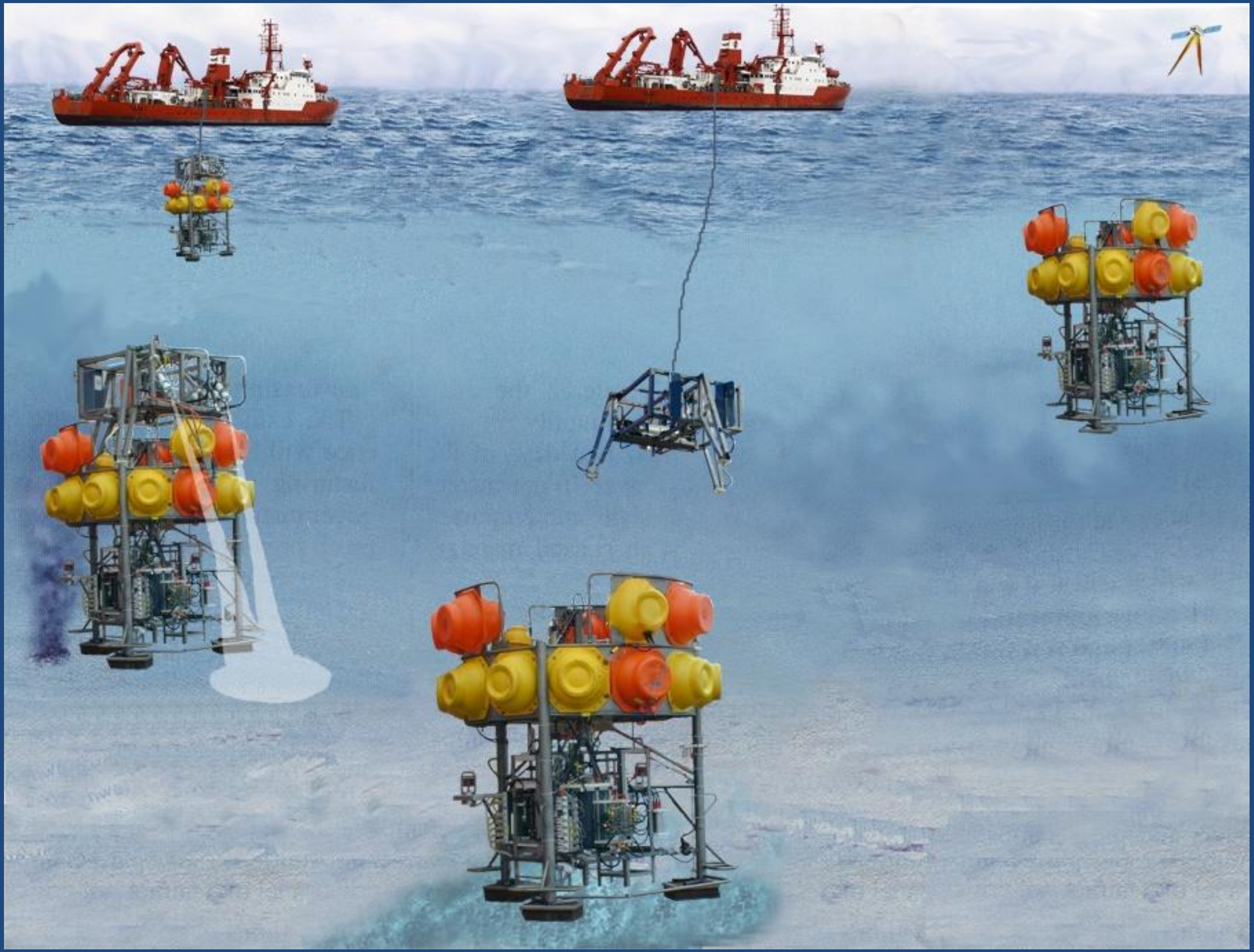
TV multicorer

- to obtain the turnover rates of AOM and SR radioactive tracers ($^{14}CH_4$ & $^{35}SO_4^{2-}$) are used for incubation of the sediments.
- CARD-FISH is applied to identify and quantify specific microbial groups in seep sediments.
- To understand the control mechanisms and dynamics of the benthic methane filter sediment flow through systems are used.

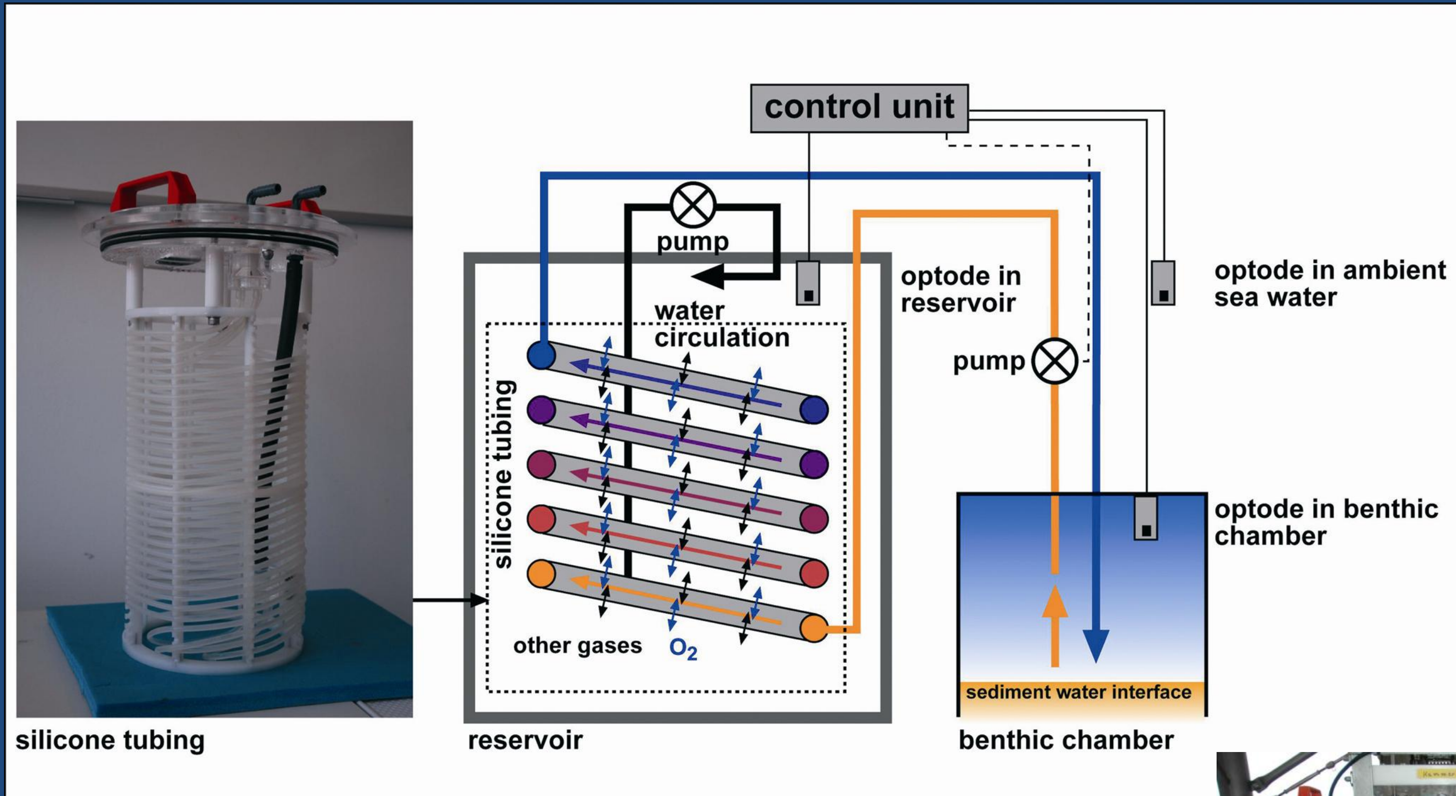


Schematic picture of the sediment flow through system (Steeb, 2010)

Methods: Video-guided Lander deployments for in situ measurements at the interface



Methods: Video-guided Lander deployments for in situ measurements at the interface



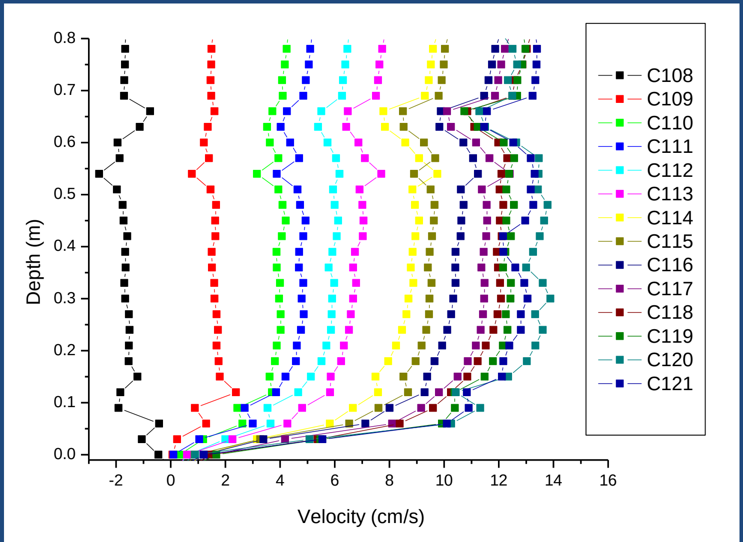
BIGO
Biogeochemical Observatory

Sommer et al., 2008

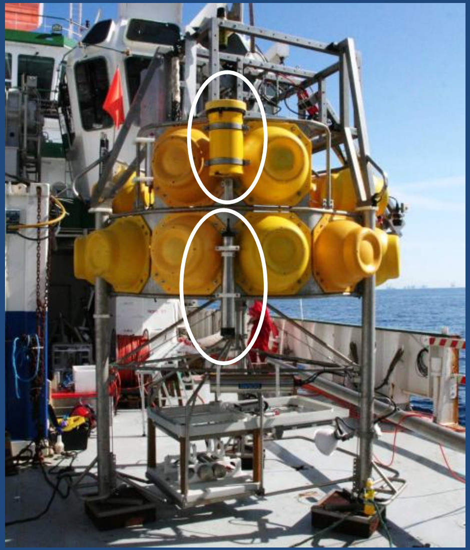
2 benthic chambers with gas exchange system -
2 modes of operation:

- O_2 inside cond. alike outside
- defined O_2 levels (stepwise)

Methods: Video-guided Lander deployments for in situ measurements at the interface



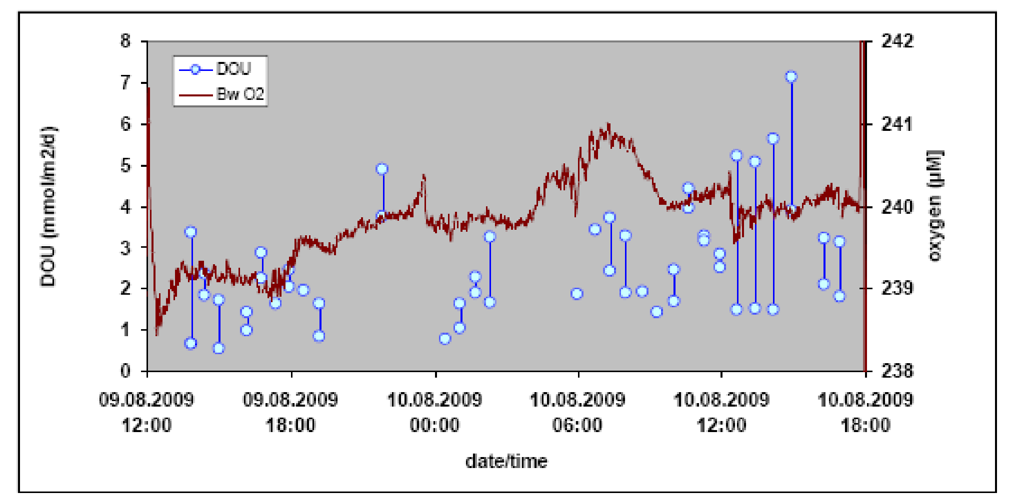
Current profile time series in the BBL. The ADP profiles show the temporal evolution (starting with the black) of the increasing current direction with a 15-minute resolution.



Profiler Lander

with ADCP (top white circle), high-resolution ADP (bottom circle) and profiler (below).

Temporal variability of diffusive oxygen uptake (DOU) calculated from O_2 microprofiles in comparison to O_2 fluctuations in the bottom water.

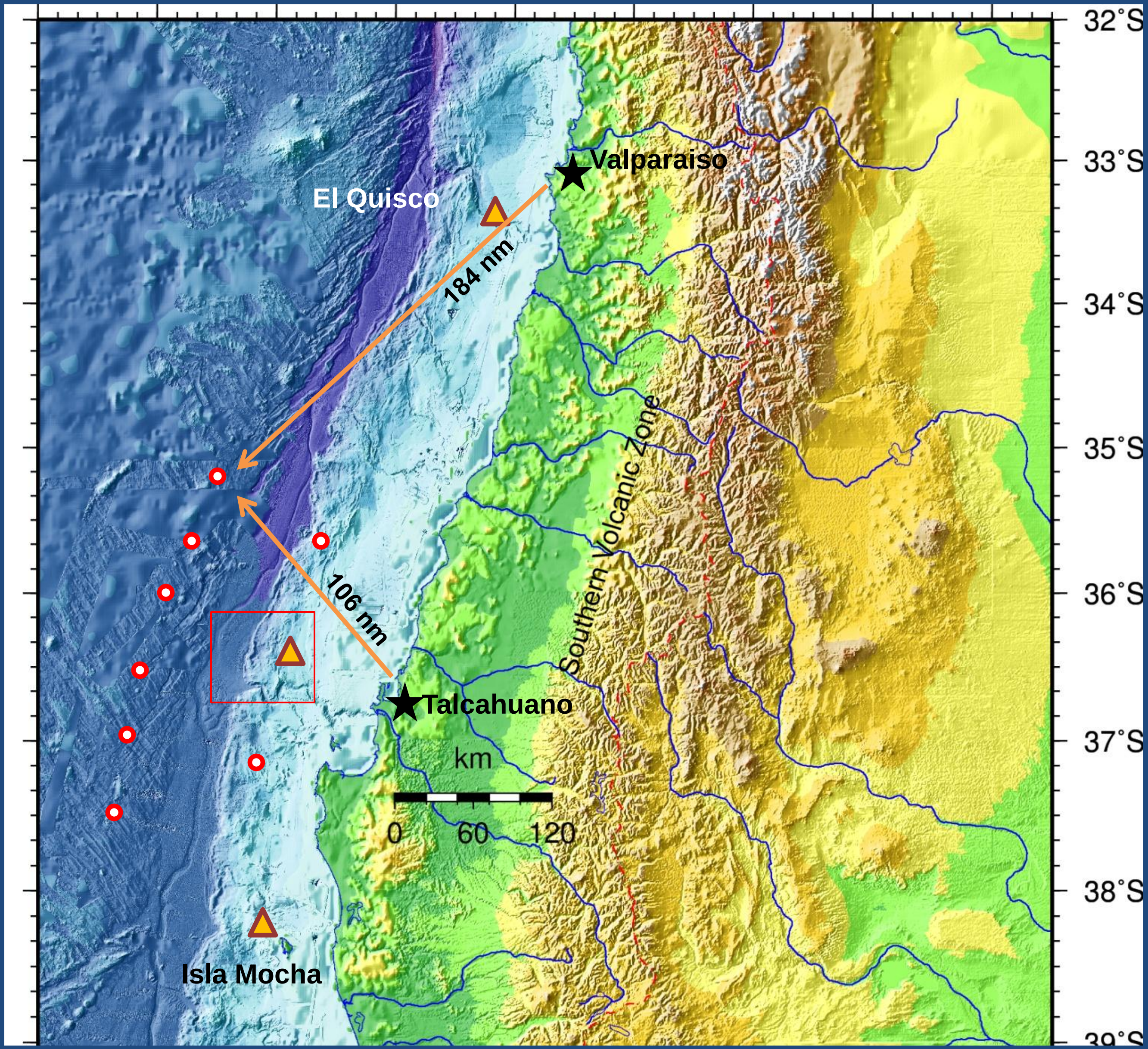


Profiler with microelectrodes (O_2, pH)

Cruise track:

23.09.2010 Valparaiso
- 26.09.2010 Departure
31.10.2010 Arrival
-01.11.2010 Valparaiso

12.10.2010 Valparaiso
Limited crew exchange



Long gravity cores for sediment & tephra stratigraphy

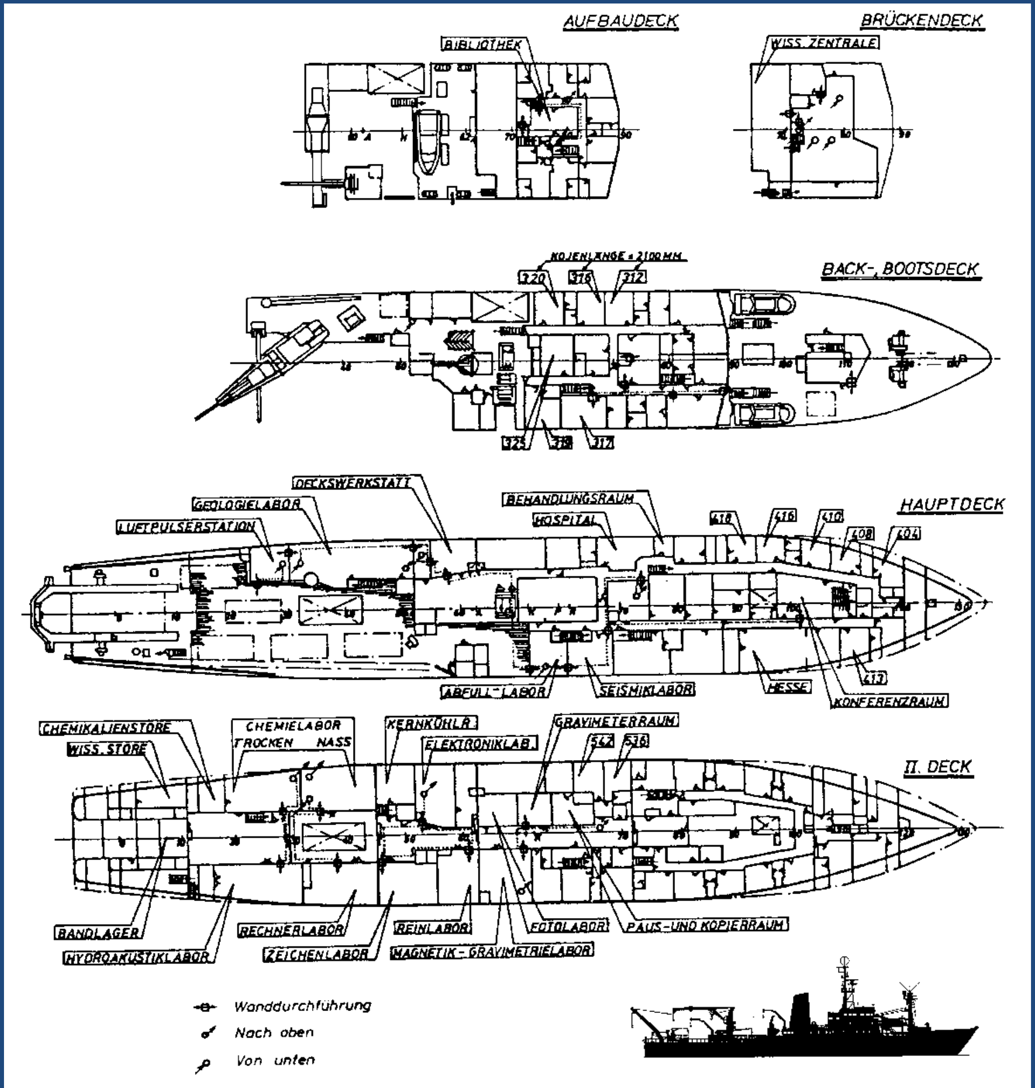
Cold seep activity

23.09.2010 -26.09.2010	Valparaiso Departure
12.10.2010	Port call
31.10.2010 - 01.11.2010	Arrival Valparaiso

Max. 27 berths for scientific crew (8 for ROV crew)
- Guest scientists
- Questionaire
- Flight reservations/booking
- Transport arrangements
- Medical examination
- Passports

Diplomatic clearance

Scientific & logistic meetings

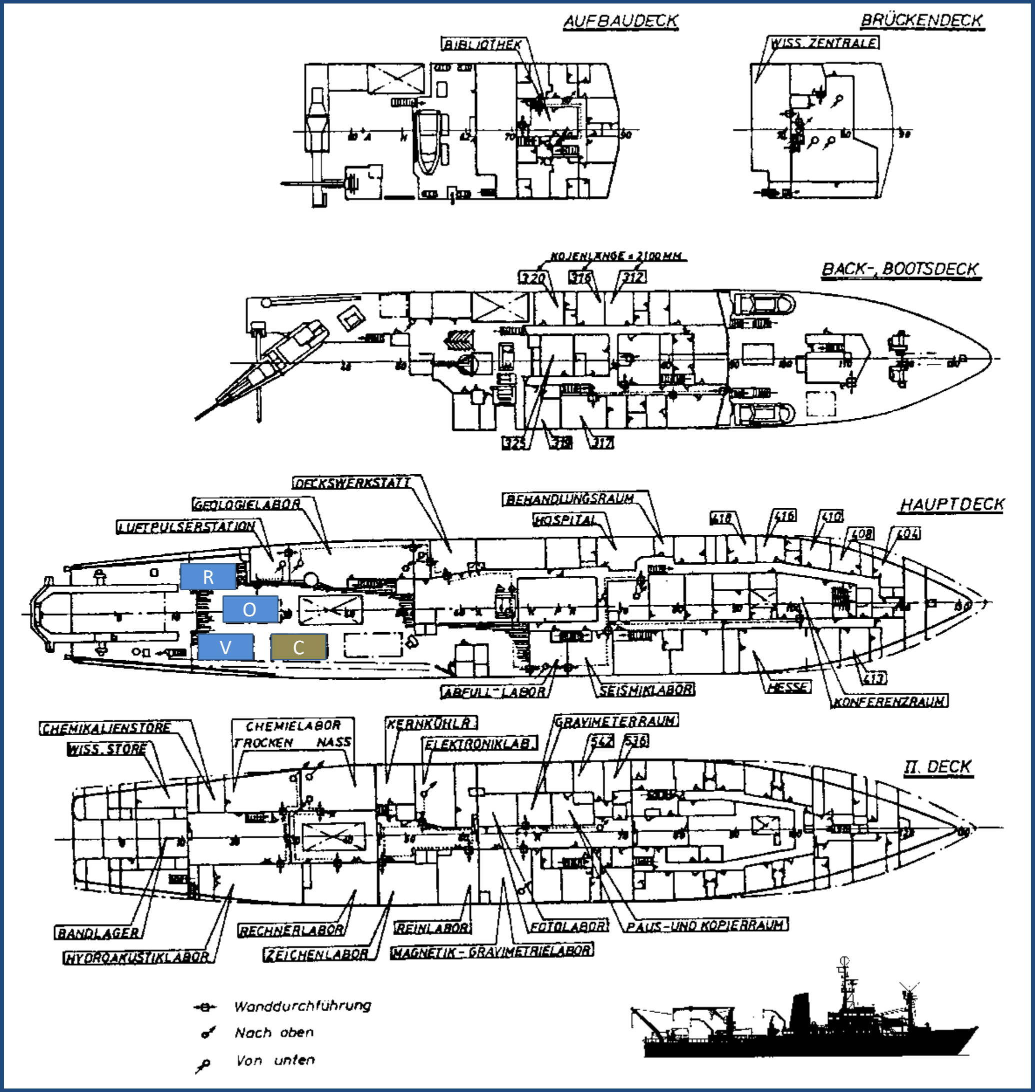


Major instrumentation:

- ROV „Kiel 6000“
- OFOS (RF)
- CTD (RF) with additional sensors
- 3 Lander (BIGO, Profiler, POZ)
- Elevator
- TV-MUC
- TV-Grab
- Gravity corer

Container transport:

6 weeks ahead (1st week in August)
ROV: 5 x 20‘ Container (3 on board)
Coring container
Cool-Container in lower hold



Logistics: Preliminary crew list

	Participant (Leg 1)	Institution	Exch. Particip. (Leg 2)	Institution	Working area (Leg 1)	(Leg 2)
1	Linke, Peter	IFM-GEOMAR/B3			Chief scientist	
2	Völker, David	SFB574/A1			Hydrosweep/Parasound/Sediments	
3	Geersen, Jacob	SFB574/A1			Hydrosweep/Parasound/Sediments	
4	Bodenbinder, Andrea	IFM-GEOMAR/B3	Sommer, Stefan		Methane / Oxygen	Lander/Benthic Fluxes
5	Treude, Tina	IFM-GEOMAR/B3			Microbiology	
6	Steeb, Philip	SFB574/B3			Microbiology, PhD	
7	Rovelli, Lorenzo	IFM-GEOMAR/B3	Bryant, Lee	Virginia Tech	CTD, Eddy Correlation	
8	Wefers, Peggy	SFB574/B3			Methane	
9	Scholz, Florian	IFM-GEOMAR/B5			Porewater Geochemistry	
10	Domeyer, Bettina	IFM-GEOMAR/B5			Porewater Geochemistry	
11	Surberg, Regina	IFM-GEOMAR/B5			Porewater Geochemistry	
12	Lomnitz, Ulrike	IFM-GEOMAR/B5			Porewater Geochemistry	
13	Liebetrau, Volker	IFM-GEOMAR/B6			Carbonates/Isotope geochemistry	
14	Kutterolf, Steffen	SFB574/C4	Kriwanek, Sonja	IFM-GEOMAR/B3	Tephrostratigraphy/Sedimentology	Lander/Benthic Fluxes
15	Freundt, Armin	SFB574/C4	Camilli, Rich ?	WHOI/B3	Sedimentology	In situ mass spec
16	Bannert, Bernhard	Oktopus	Türk, Matthias	IFM-GEOMAR	Video-technician, TV grab	Lander-Electronics
17	Cherednichenko, Sergiy	IFM-GEOMAR		IFM-GEOMAR	Lander-Electronics	
18	NN	UCV			Seep Macrofauna/Chilean Observer	
19	Petersen, Asmus	IFM-GEOMAR			Coring	
20	Queisser, Wolfgang	IFM-GEOMAR			TV-MUC/ROV-Winch	
21	Abegg, Fritz	IFM-GEOMAR			ROV-Coordinator/Pilot	
22	Pieper, Martin	IFM-GEOMAR			ROV-Mechanics/Pilot	
23	Hussmann, Hannes	IFM-GEOMAR			ROV-Electronics/Pilot	
24	Cuno, Patrik	IFM-GEOMAR			ROV-Programming/Pilot	
25	Meier, Arne	IFM-GEOMAR			ROV-Winch/Pilot	
26	Suck, Inken	IFM-GEOMAR			ROV-Pilot	
27	Foster, Andrew	Schilling Robotics			ROV-Pilot	