Application of the In-Spectr 200 MIMS for measurements of methane in Lake Constance and the W-Baltic Sea

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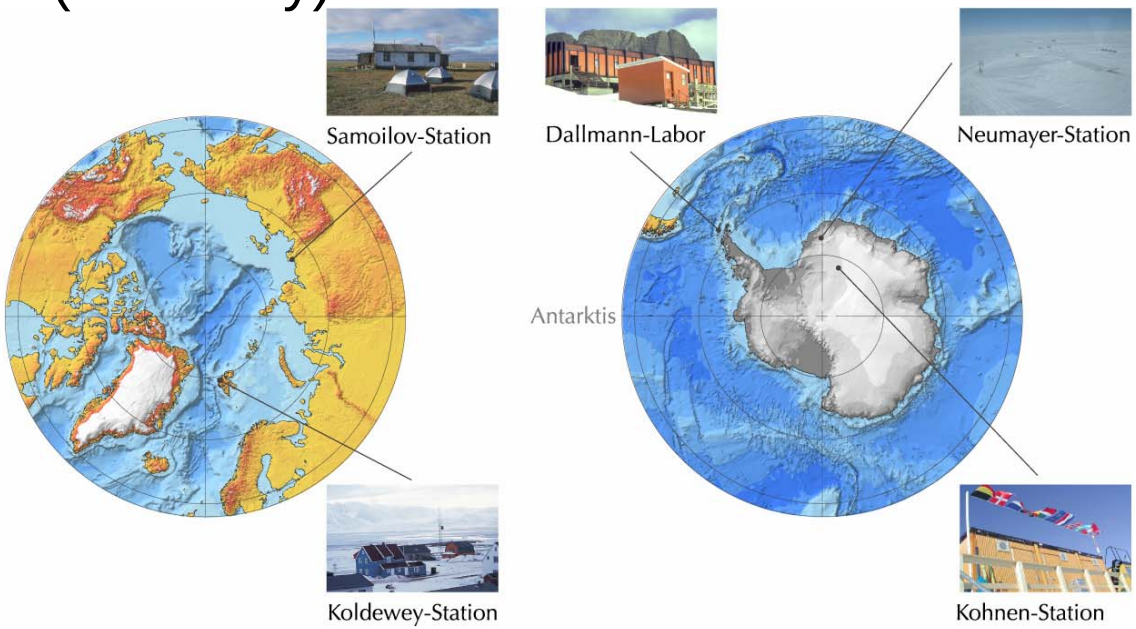


Investigating the high latitudes to improve the understanding of the Changing Environment

Deep-Sea, Shelf, Coastal Zone to Permafrost

Ice covered regions & Atmospheric Research

Marine Geochemistry

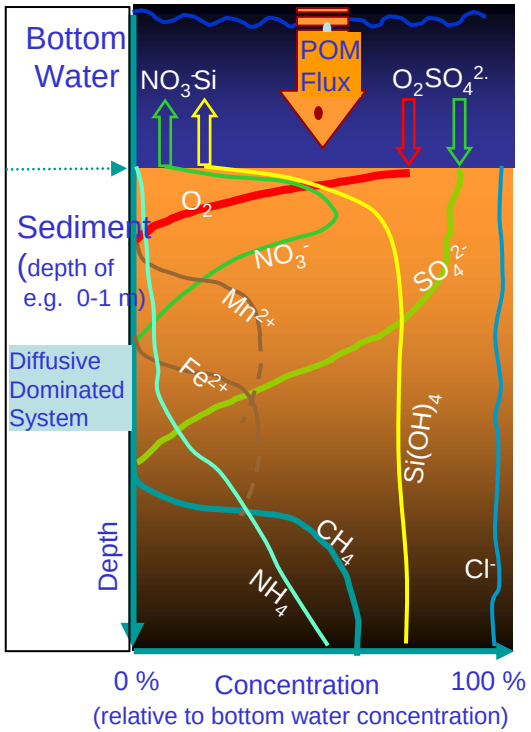
In the department of Marine Geochemistry we are investigating geochemical cycles in the water column and sediments of the ocean and coastal environment.

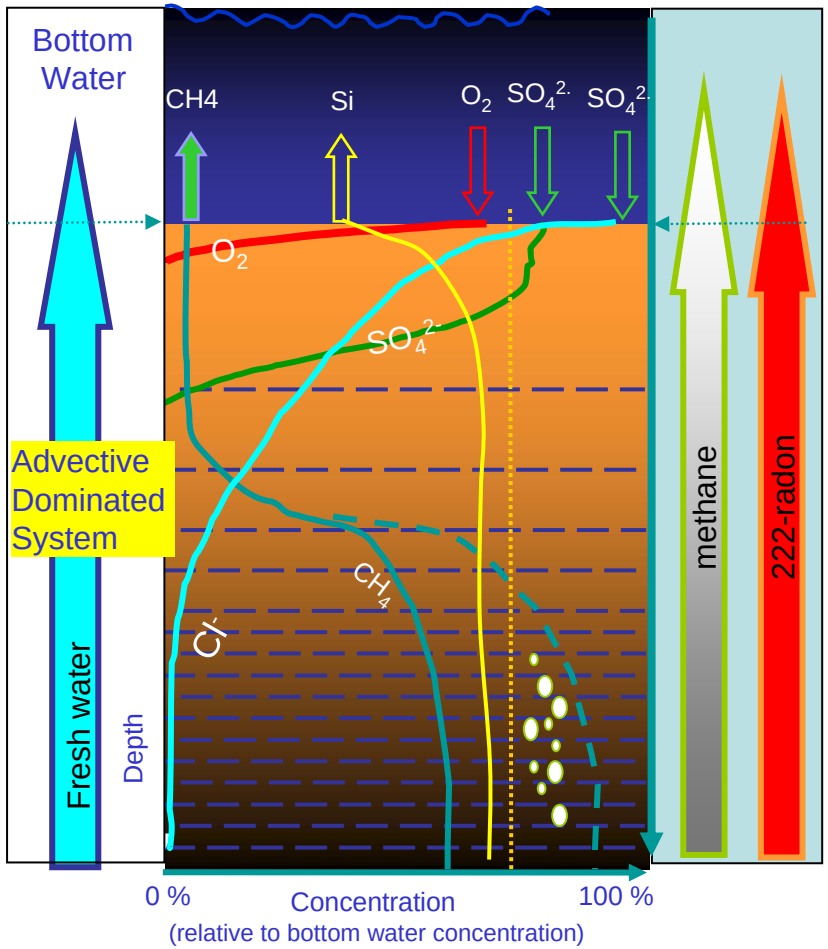
Specific objectives are:

- the production and fate of methane
- in situ measurements by micro-profiler and chamber systems to determine organic carbon fluxes to the seafloor
- microbial degradation process in surface sediments
- investigation of natural radio nuclides (^{234}Th, ^{222}Rn, ^{226}Ra, etc.) to trace transport pathways.
- studies of fluid flow at Mud Volcanoes, Pockmarks, or Seeps
- application of Geo-Information-Systems for spatial budgets

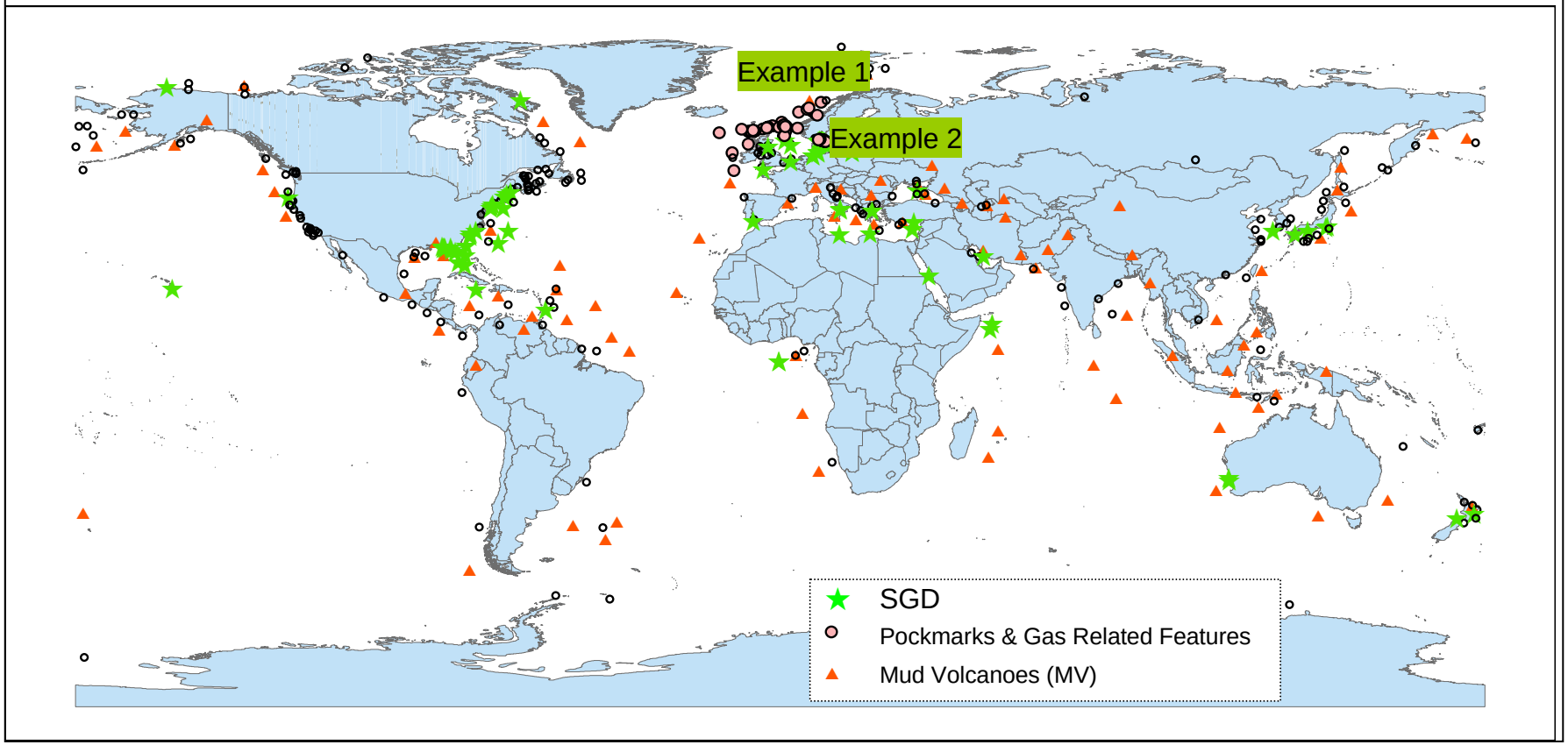
For these purpose we apply and develop analytical techniques and in situ systems.

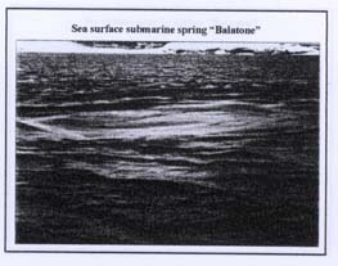
Fluid flow processes: transfer of CH4 into bottom water

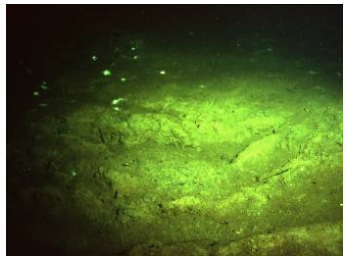




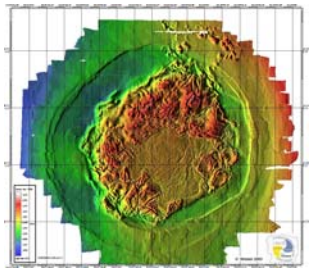
Fluid Flow at continental margins and coastal zones

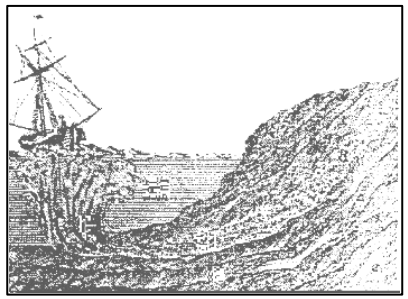






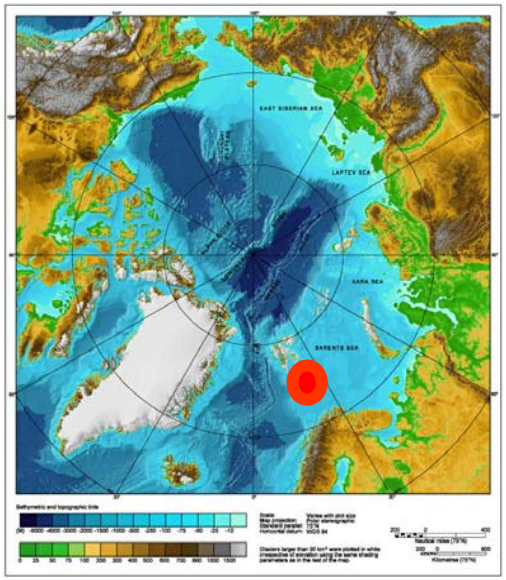
Submarine Groundwater Discharge
in Karst and Soft Sediment Environments

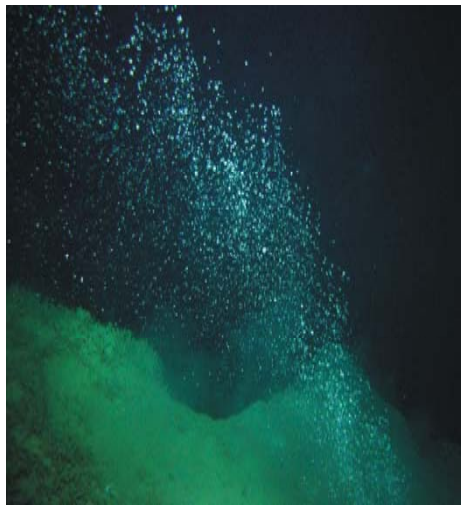


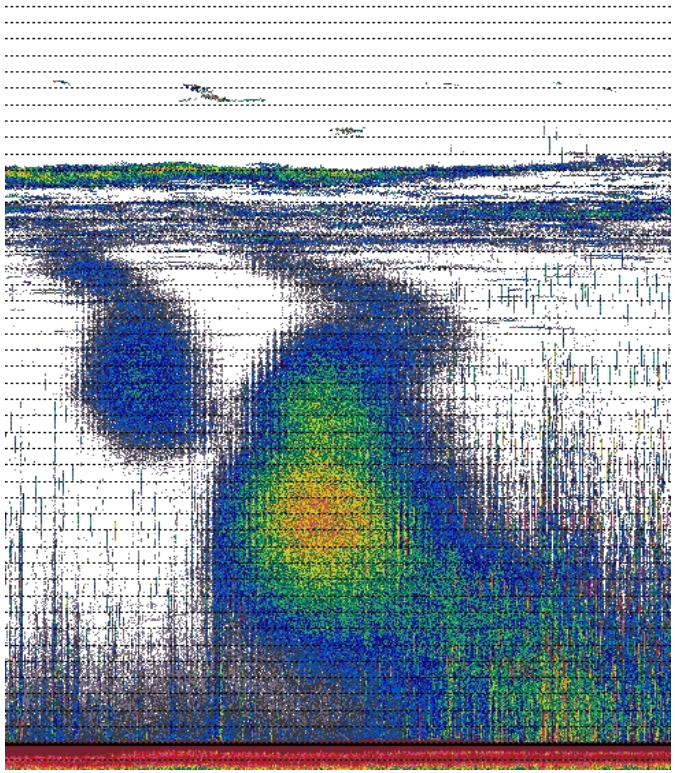


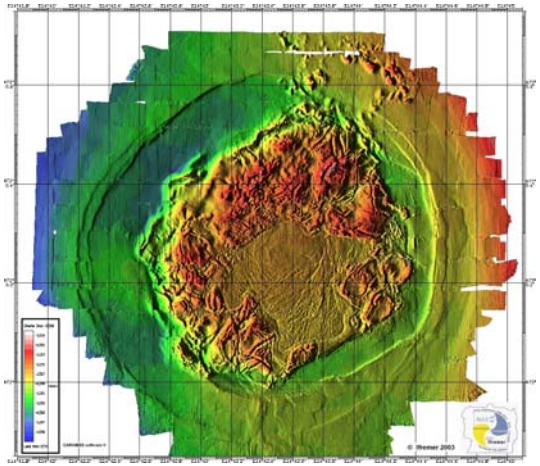
Fluid Flow at Margins:
Cold Seeps, Mud Volcanoes, ..

Example 1: Methane release and occurrence of gashydrates at Hakoon Mosby Mud Volcanoes









IFREMER & AWI

From seafloor visual observations we estimated a gas flux of 0.2 (0.08 - 0.36) mol s^{-1} which translates to several hundred tons per year.

Gas bubles were covered by gashydrates and rise from the seafloor to water depth of at least 400m.

In situ analysis of methane and other gases: At present just two devices

Solid state
in situ methane analyser

No calibrate-able, „quantitative“ Sensor

In situ Mass-Spectrometer

In situ Mass Spectrometer for analysis of trace gases as CH4

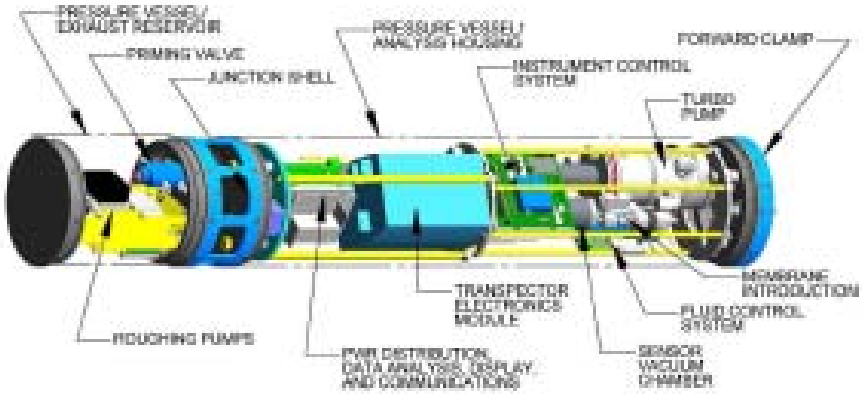
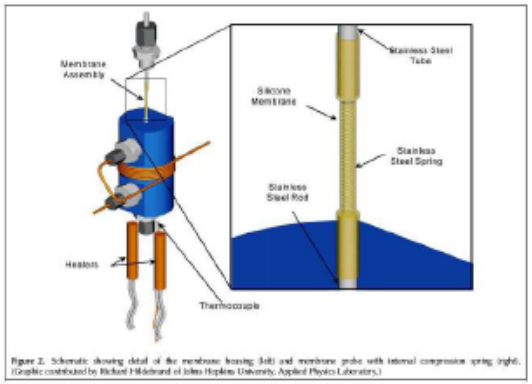


Abbildung 26: Schematischer Aufbau des Inspectr200-200



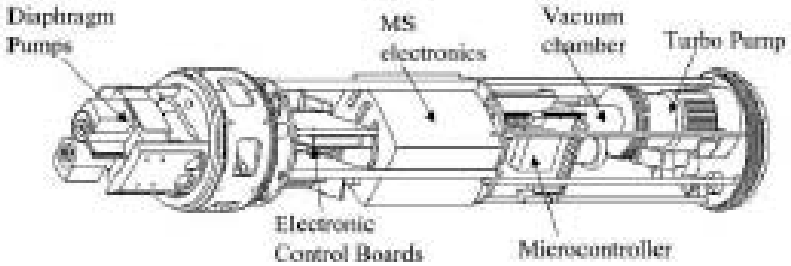


Abbildung 28: Membran in Originalgröße

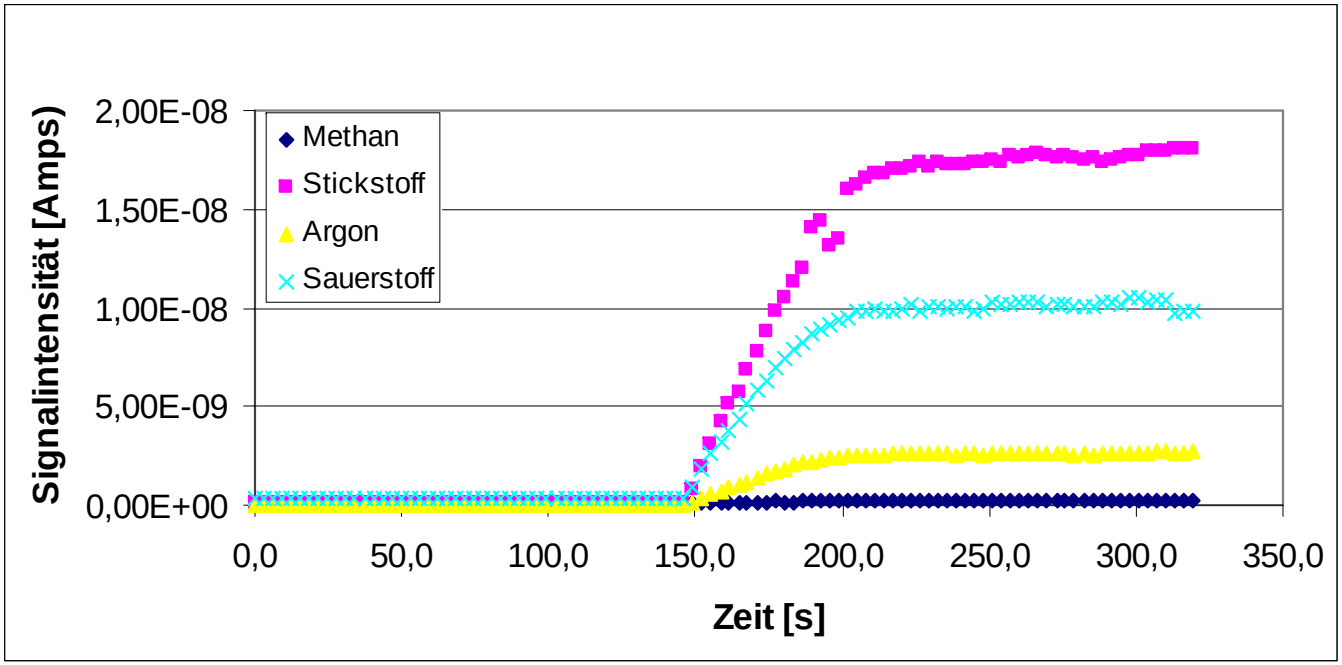
Membrane Introduction Mass Spectrometer
Rated to 200m (1000m)
AMU 1-200

Abbildung 29: Gebrauchte Membran in 70facher Vergrößerung

Abbildung 30: Gebrauchte Membran in 320facher Vergrößerung

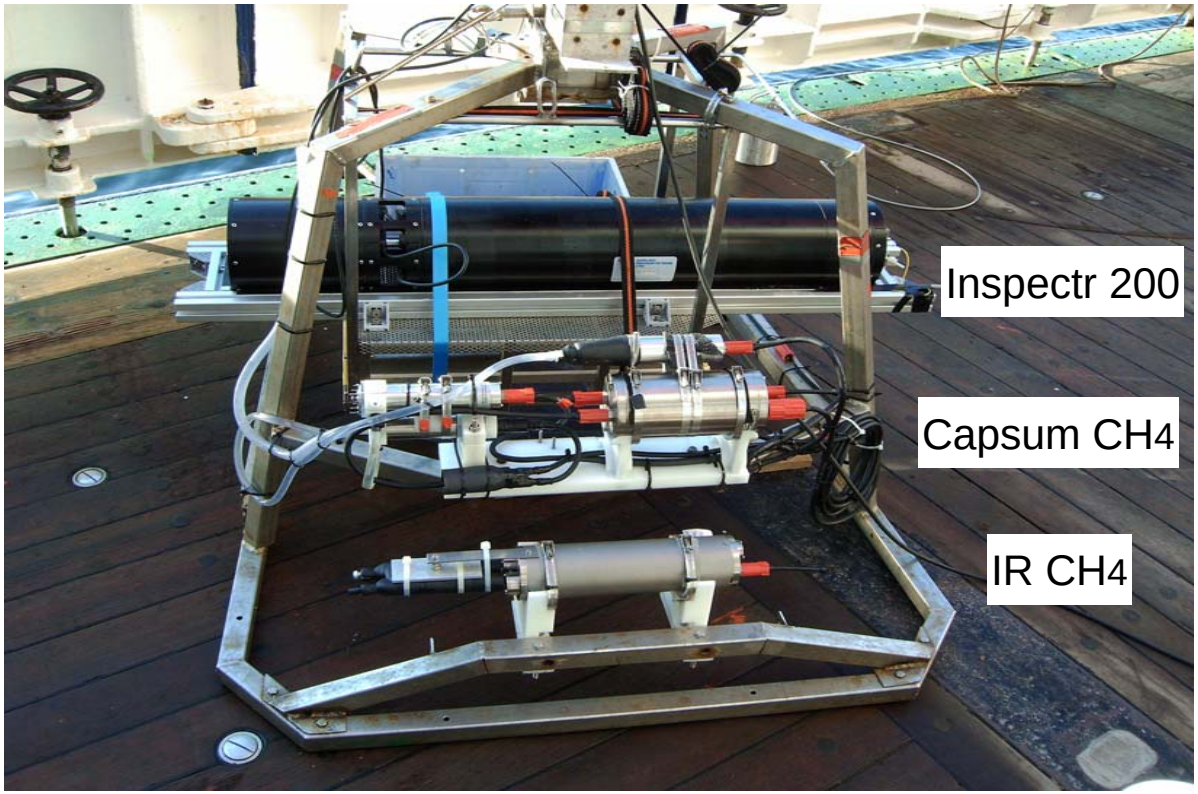
In situ
Mass Spectrometer
TCP/IP

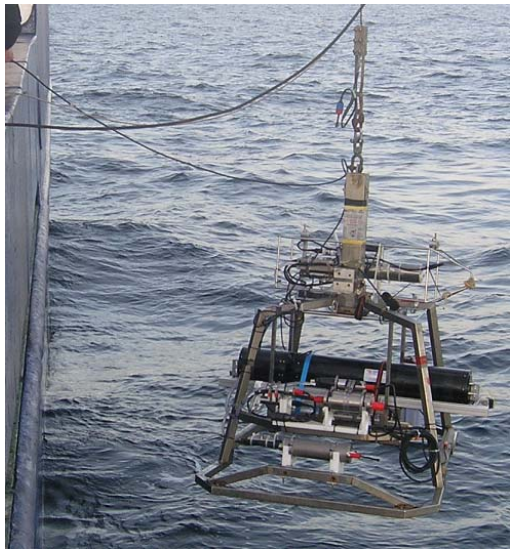
Testing the “system behaviour”: Temporal response for N2, O2, Ar



Furthermore we looked for:
dependence of flow rate, time constant of increase/decrease of concentration etc.

First in situ field test in the Baltic Sea





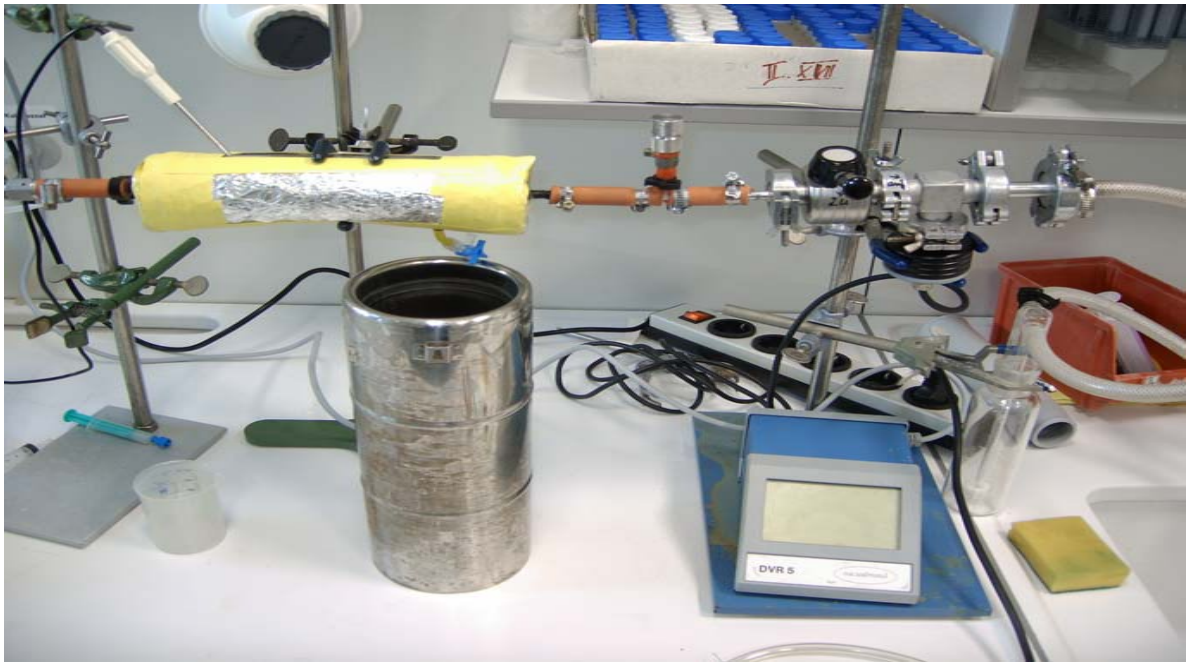
Outcome for our field of application:

- Data -> Shown later

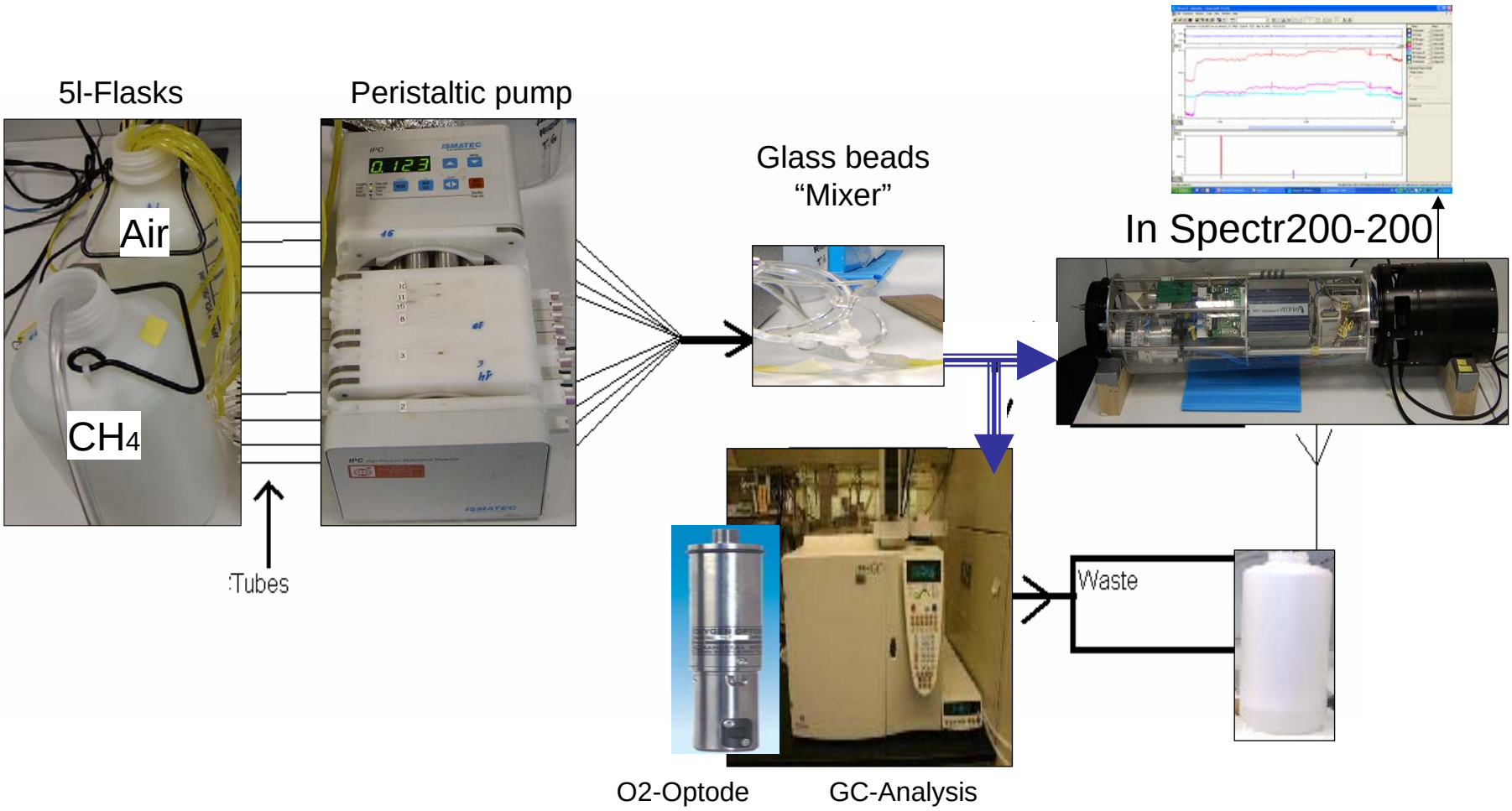
- Lower detection limit required

- Benefits by improved base line stability and reduce ion current
- “Back up“ in case of membrane failure

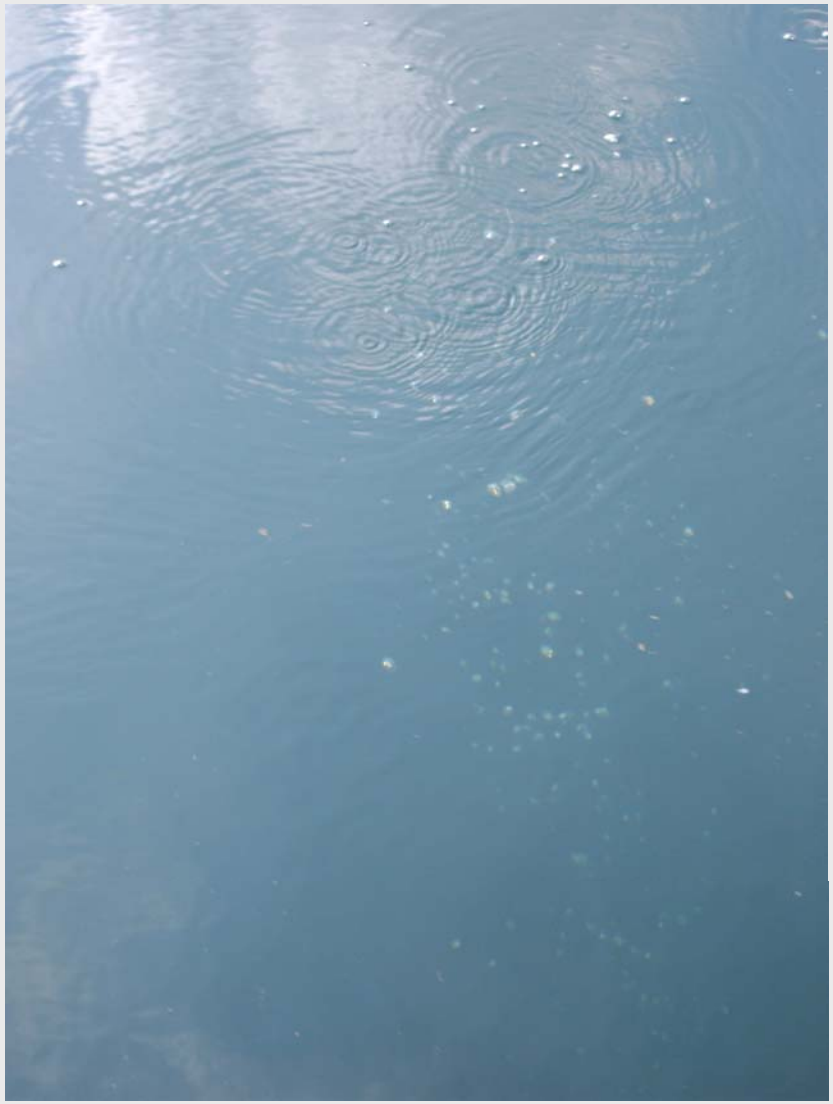
“Prototype” of Cold-Trap System



Set up for the calibration of the In Spectr for CH_4, O_2 etc.



Field Data




Bremerhaven
Hamburg
Amsterdam
Berlin
Brussel
Luxembourg
Praha
Bern
Image NASA
© 2007 Europa Technologies
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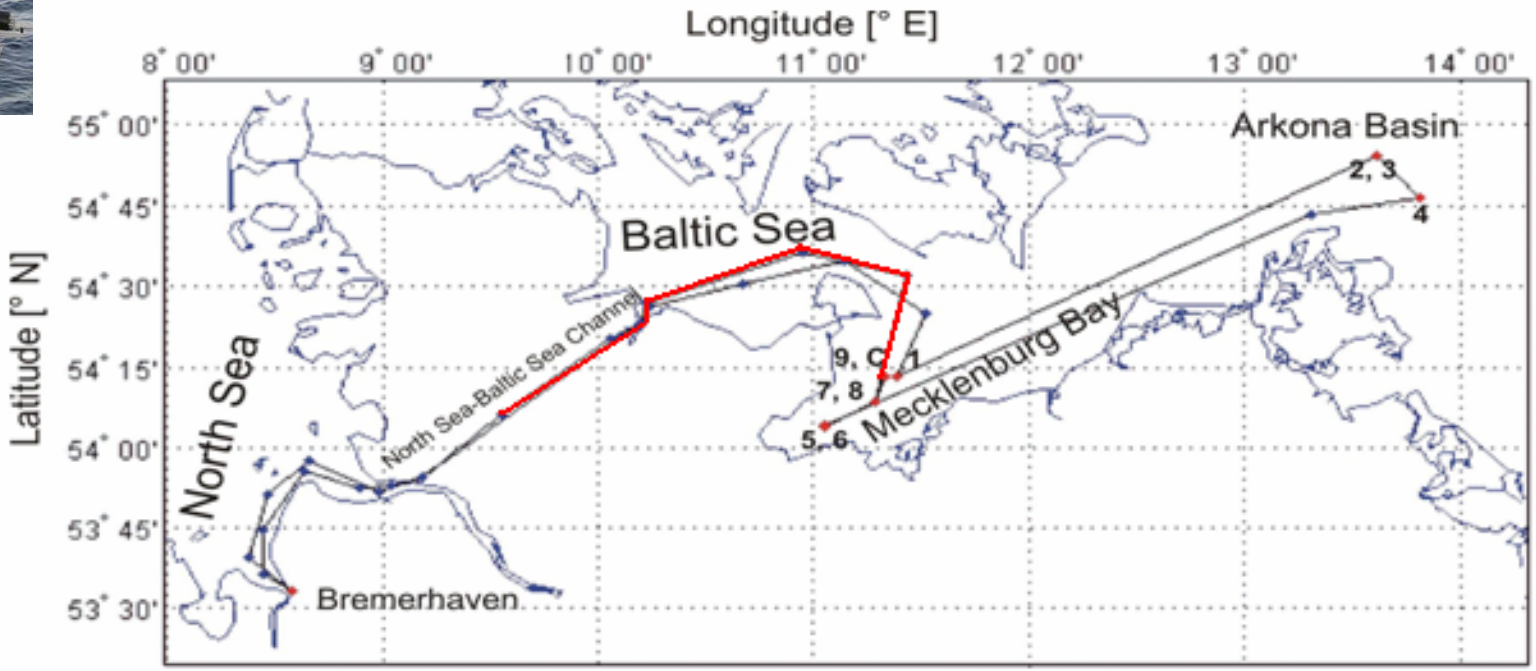
Image © 2007 GeoContent
Zeiger 51°14'10.07" N 11°51'52.28" O Übertragung 100%

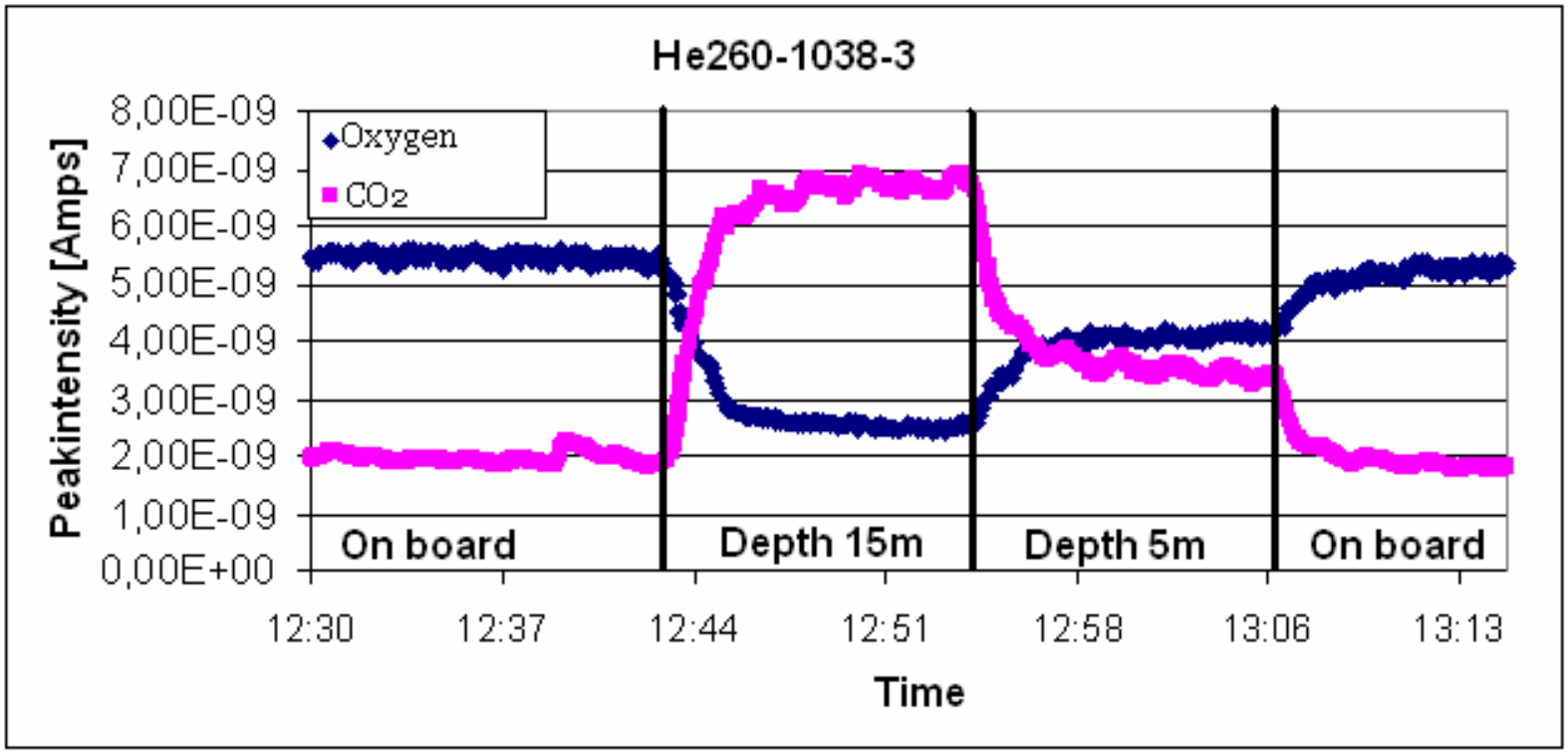
Deployment of the In-Spectr 200 in the Baltic Sea



Station	Point	Area	Lat	Long	Lat(dec)	Long(dec)	Waterdeth	Date	Time
			N	E	N	E	m		
1038-1	**6**	MB	54° 04.02'	11° 02.93'	54.067	11.049	19.2	11.09	08:00
1046-1	**8**	MB	54° 08.61'	11° 17.01'	54.144	11.284	21.9	11.09	18:09

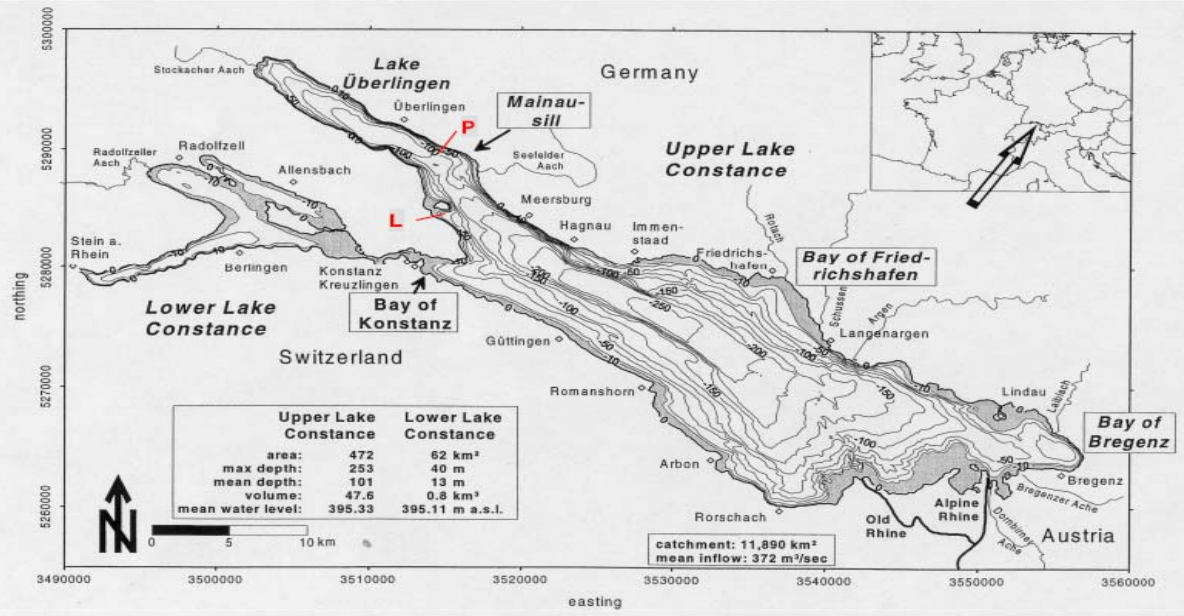
Deployment of the In-Spectr 200 in the Baltic Sea

Methane and Oxygen concentration in coastal waters of the Baltic Sea

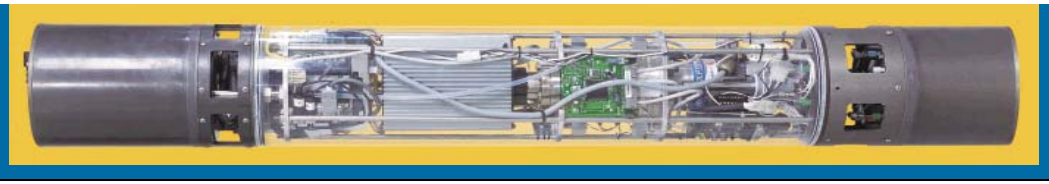


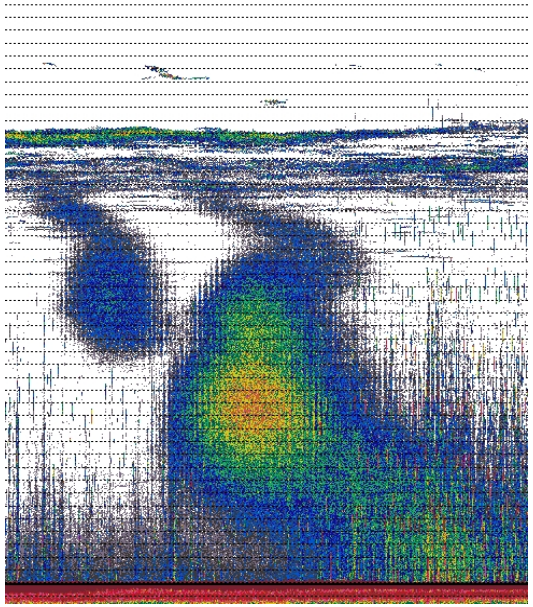
Online Measurements of methane in Lake Constanz

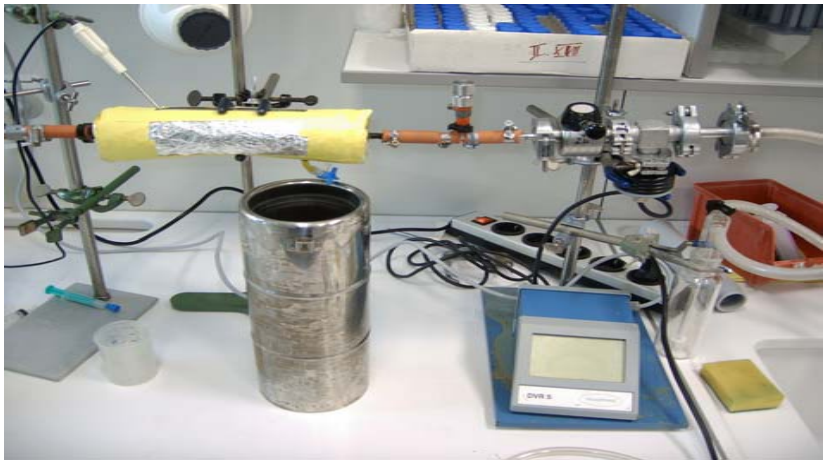
Online measurements of methane concentrations in surface waters of Lake Constanz

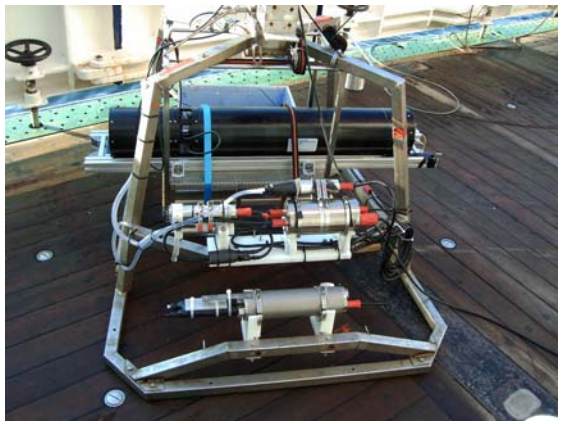


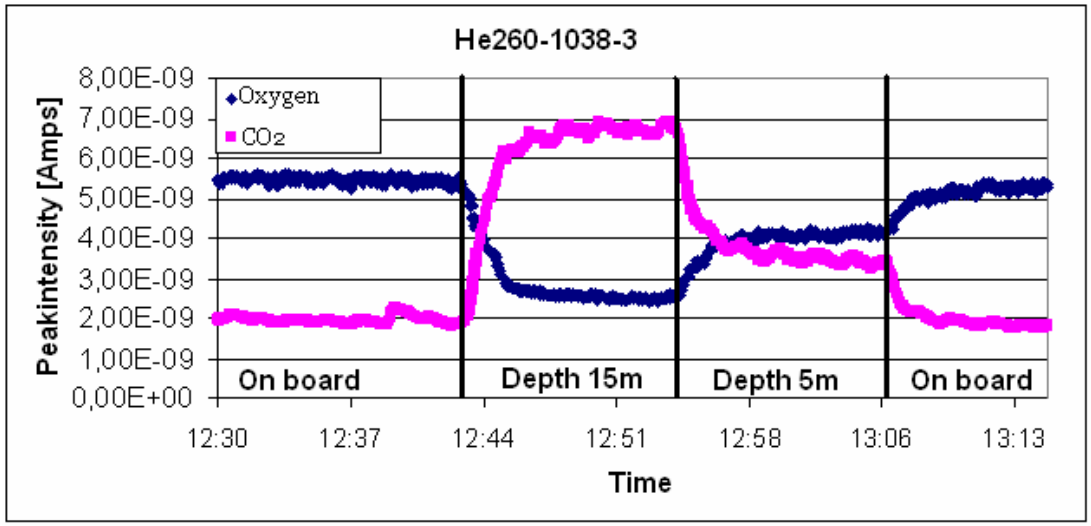
Conclusion










He260-1038-3
Oxygen
CO2
Peakintensity [Amps]
8,00E-09
7,00E-09
6,00E-09
5,00E-09
4,00E-09
3,00E-09
2,00E-09
1,00E-09
0,00E+00
On board
Depth 15m
Depth 5m
On board
12:30
12:37
12:44
12:51
12:58
13:06
13:13
Time