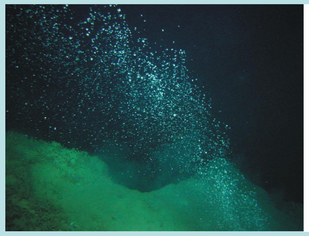
Online membrane inlet mass spectrometry (Inspectr200-200) for quantification of the methane concentration field around Pockmarks

Torben Gentz[1], Michael Schlüter[1]

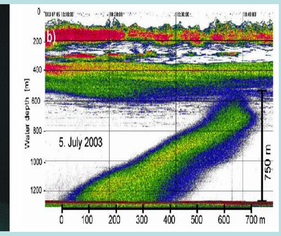
[1]Alfred Wegener Institute for Polar and Marine Research

The motivation of our work is the spatial and temporal distribution analysis of Methane around Pockmarks and other CH_4 seeps

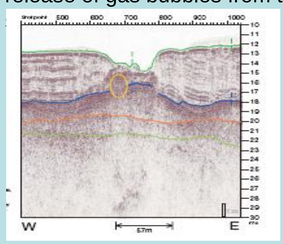
Worldwide, the release of methane from sediments of lakes, coastal regions as well as ocean margins is observed. The gas release is often associated with specific features like pockmarks (morphological depressions at the seafloor), mud volcanoes, cold seeps as well as occurrence of gas hydrates. For such sites gas plumes were observed by underwater camera systems as well as acoustic techniques.



Visual observation of the release of gas bubbles from the

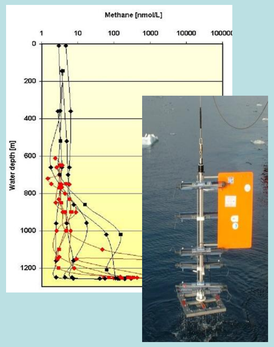


Acoustic “image” of gas bubble plumes in the water column.



Acoustic blanking in surface sediments

Chemoautotrophic organisms



Bottom Water Sampler
Sauter et al., 2002

.. often the CH_4 concentrations around “hot spots” are rather low.

Why Inspectr200-200

Compared to such semi-quantitative information, rather little-known is the concentration field of CH4 as well as other gases around e.g. pockmarks. This is mainly to the laborious sampling schemes and rather time consuming CH4 analysis by gas chromatography.

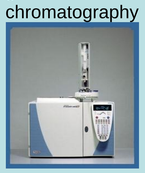
Established method

Water colum and sediment sampling

Phase separation (gas phase from aqueous phase):

Headspace technique for analysis of discrete samples

Gas analysis by gas chromatography



Problems:
-Sampling artifacts (de-pressurisation),
-time consuming,
-coarse spatial and temporal resolution
-low sampling rate

Application of MIMS is a step towards a more detailed investigation of spatial and temporal variations of methane in aquatic systems

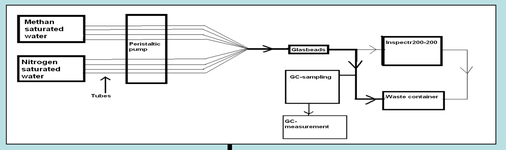
Inspectr200-200 (AML)

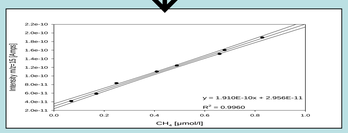
Detection of steep concentration fields of methane around pockmarks and other hotspots of CH4 seepage requires:

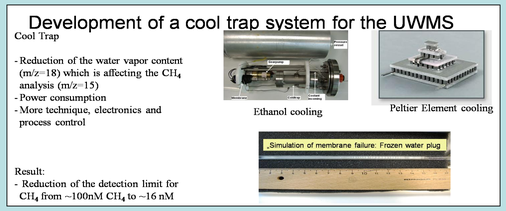
1. **Calibration within a wide range of CH4 concentration and a detection limit of <50nmol**
2. **Results comparable with established techniques like gas chromatography**
3. **High sampling frequency and fast response time**
4. **In-situ measurement to cope with sampling artifacts**

Results: Check-list of requirements

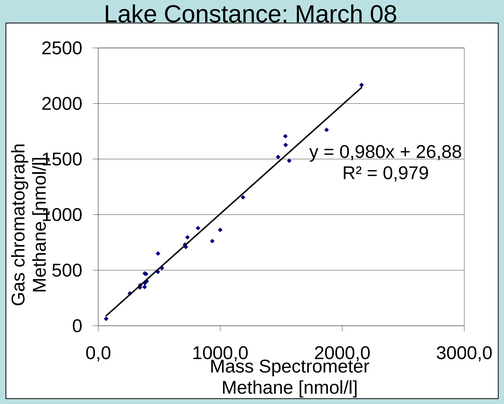
1. Calibration of methane



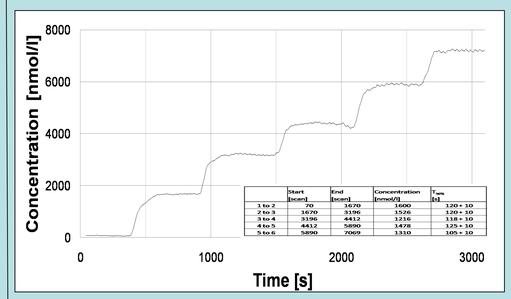




2. Comparison Inspectr200-200 to gas chromatograph
Lake Constance: March 08

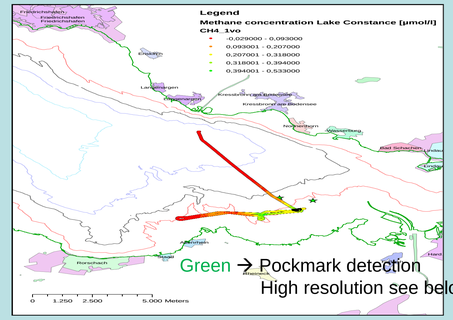


3. Response time

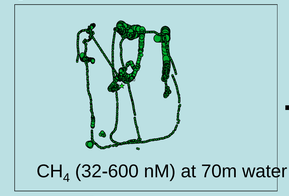


The sampling frequency is 750 times higher to the established method

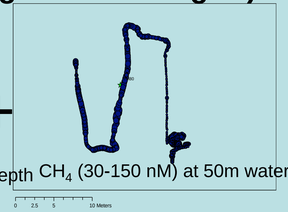
Results: Concentration field of methane around Pockmarks (Lake Constance)



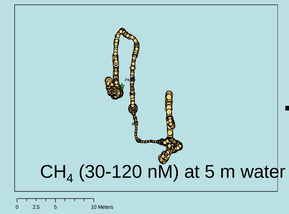
Methane distribution at different levels at a Pockmark (Measurements along a 15m*25m grid)



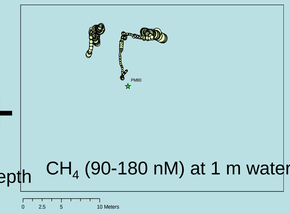
CH_4 (32-600 nM) at 70m water depth



CH_4 (30-150 nM) at 50m water depth



CH_4 (30-120 nM) at 5 m water depth



CH_4 (90-180 nM) at 1 m water depth

3-D Profiling