

**Possible leaching of pollutants from a
deep-sea dumping of harbor sediments
studied with passive sampling
techniques.**



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OSLO HARBOR

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Situation

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- Polluted harbor sediment > 1 milj ton
 - PCB
 - PAH, R-PAH
 - TBT
 - Metals
 - Etc
 - Also analysed ecotoxicity, pesticides etc.
 - Remediation
 - Transport to dumping site and to 75 meter depth
 - Pumping to bottom
 - Mixing
 - Adding salt
 - Powerful pumping to bottom in one foot tube

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Question

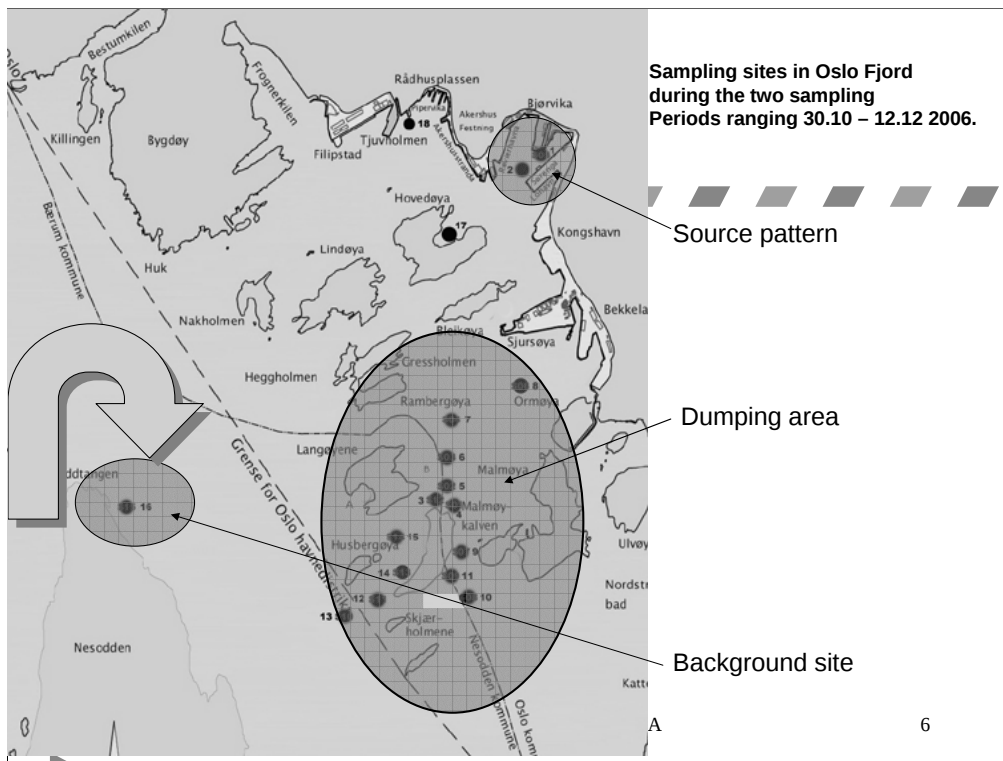
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- The task assigned was to investigate whether water dissolved chemicals are migrating from the dumped sediment to the surrounding environment outside the marked dumping area.
 - The investigation was to start as soon as possible.



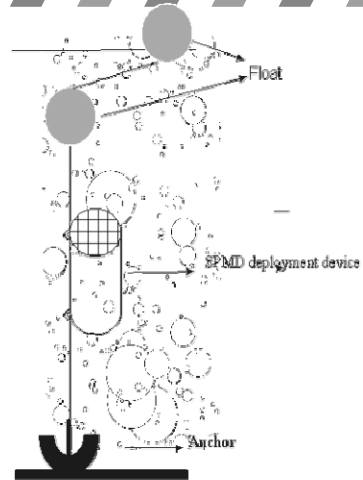
Photo: Viktor Jæger, Oslo Fjord

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Deployment



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Background information



• **SAMPLING PLAN**

- Two times 3 week sampling
- Sampling at one to four depth.

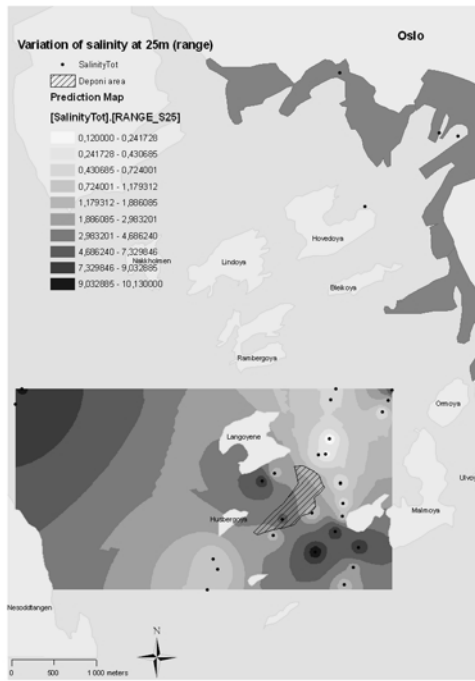
• **SAMPLING PROBE** (every foot sampling)

- Water temperature
- Salinity
- Climate
- Dumped amount during time periods



Variation of salinity at different depths during the study.

, 2007, USA



Variation of salinity at 25 meter from sea bottom.



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Variation of salinity at 3 meter from sea bottom.

, USA

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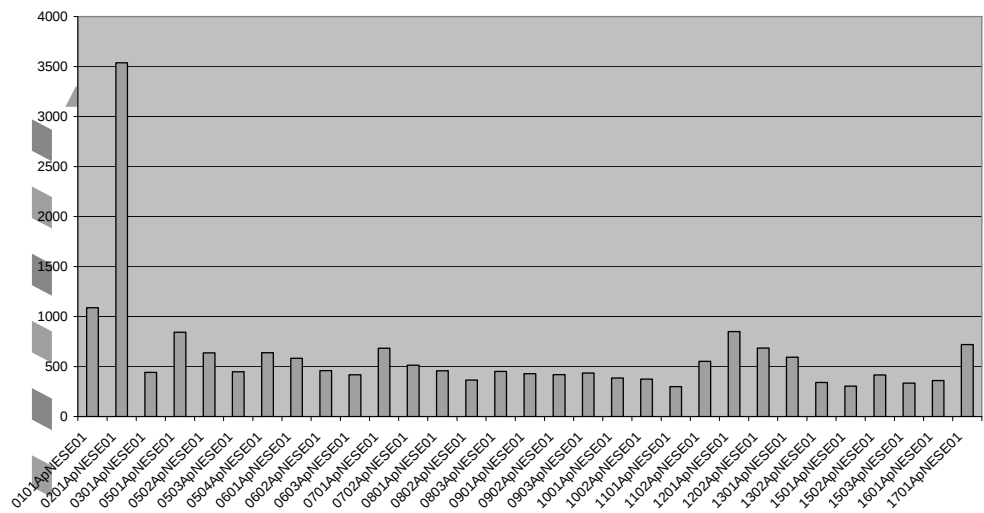
Analysis

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- One membrane dialysis extract splitted into several portions for different targets.
 - GC/MS Ion trap or GC/HRMS
 - 8 PRC compounds + 1 CS (corruption compound)
 - PRC compounds all labeled.
 - Full model for concentration calculations used.
 - All data corrected for lab blank
 - **Field control** samples for field problems and PRC calculations.
 - I do not like expression field blank. (not zero, dissipate)

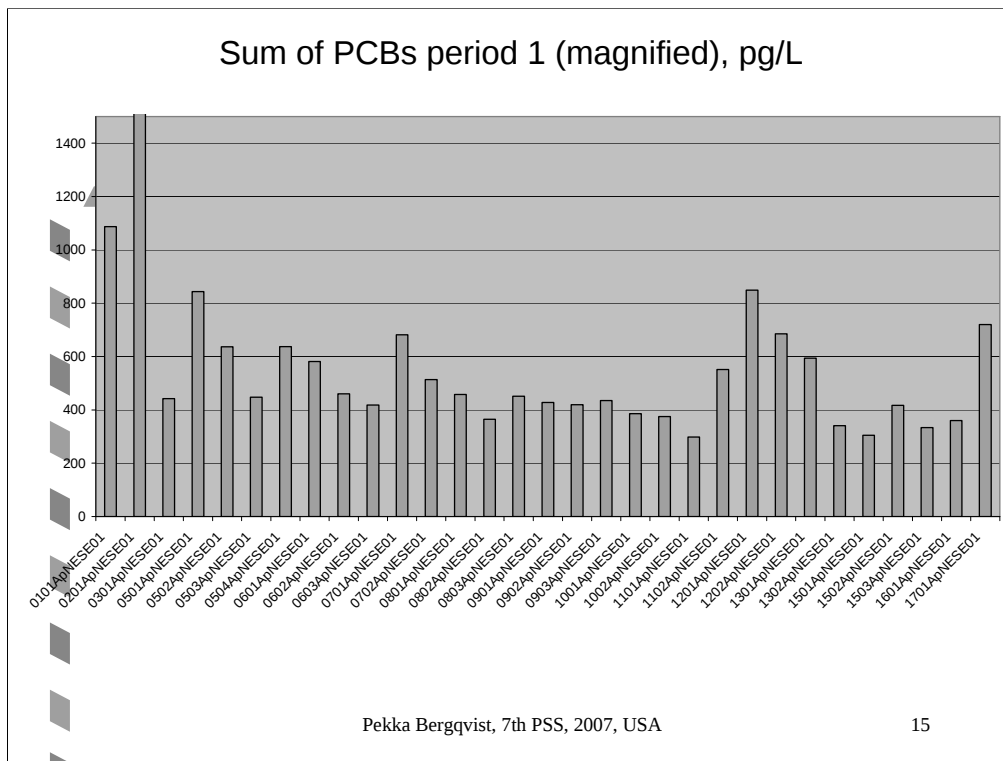
Labeled PRC analysis from FC

	μg/SPMD			mean	STD
Acenaften D10	6.76	6.75	6.46	6.7	0.17
Fluoren D10	7.41	6.83	6.27	6.8	0.57
Fenantren D10	10.5	9.68	9.56	9.9	0.51
Chrysen D12	10.5	10.3	10.8	11	0.25
	ng/SPMD				
PCB3_C13	39.2	41.3	37.3	39	2.0
PCB8_C13	50.9	52.5	47.7	50	2.4
PCB37_C13	74.0	66.2	74.3	72	4.6
PCB54_C13	56.5	62.1	57.3	59	3.0
OCN	783	766	802	784	18.0
FLU 63 times					
PCB3 2 times					
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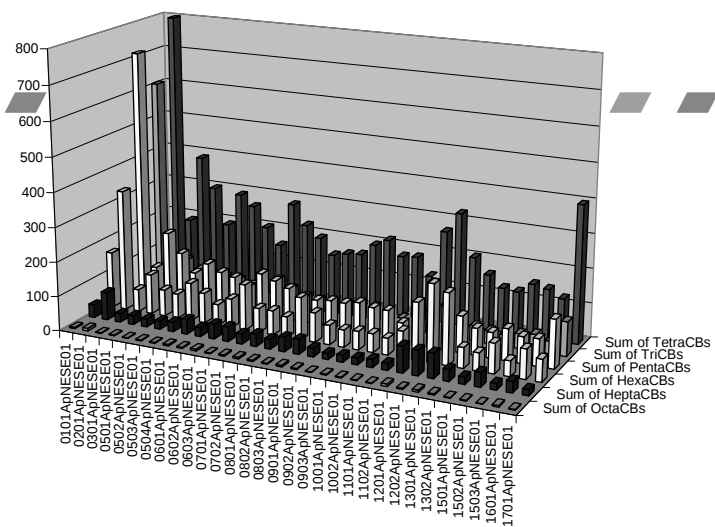
Sum of PCBs period 1, pg/L



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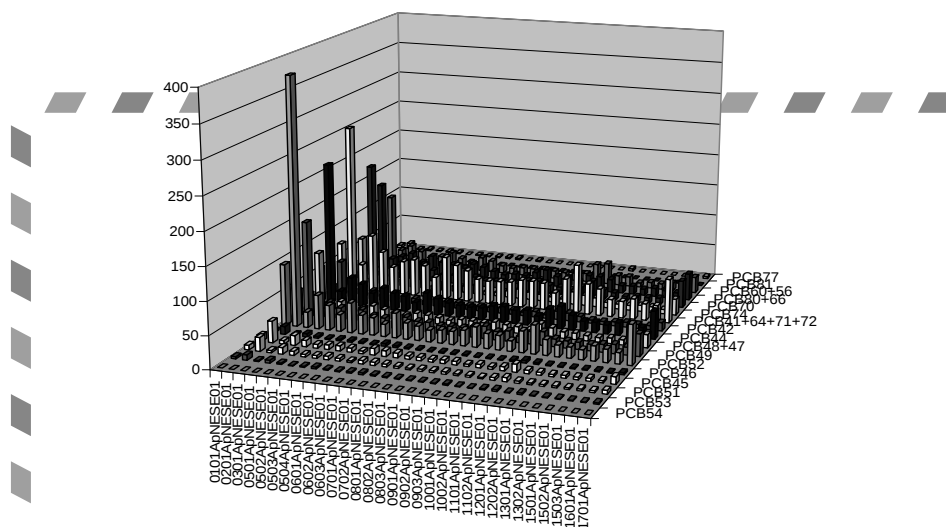
Sum of congener groups of PCBs period 1, pg/L



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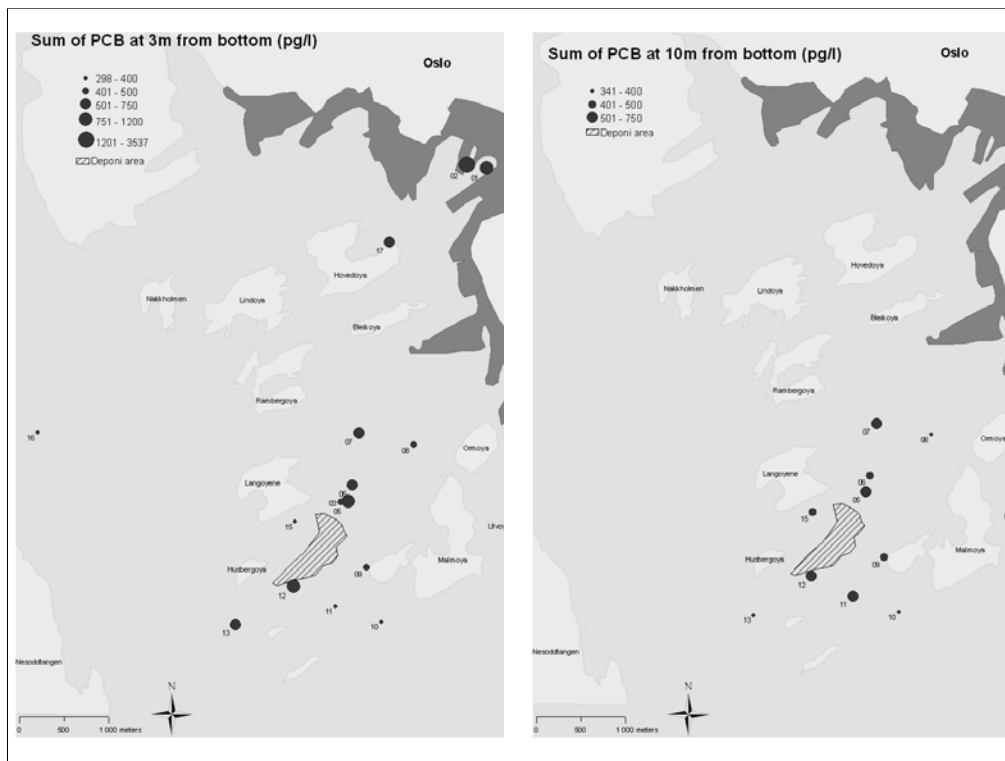
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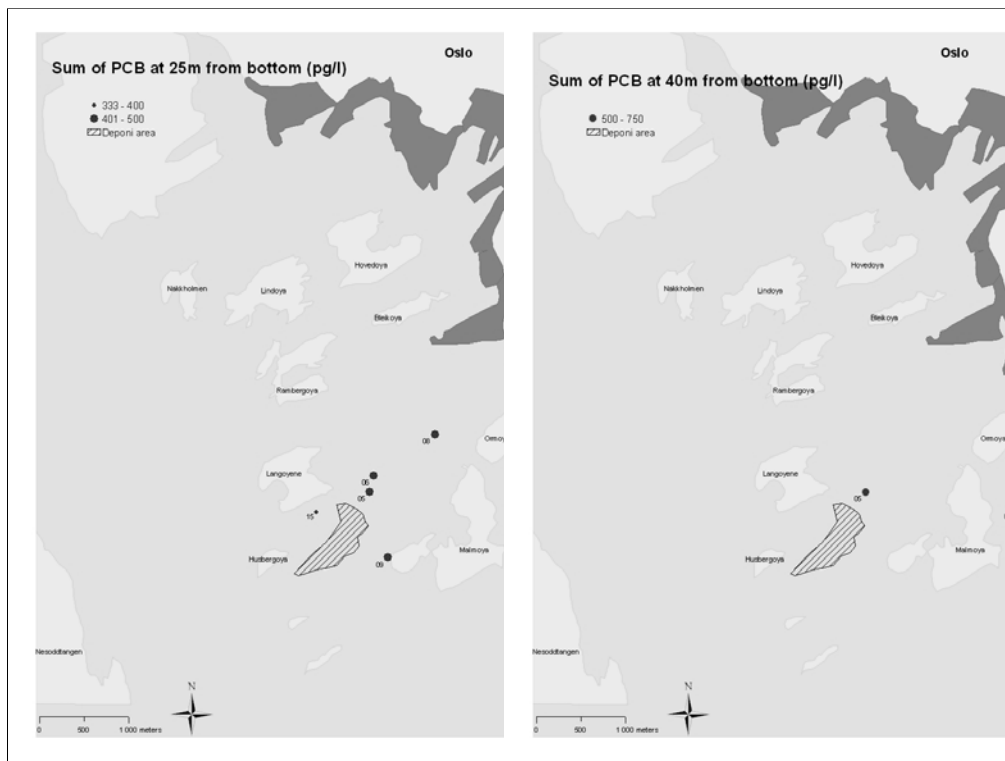
Isomer pattern of tetra-CB from period 1, pg/L



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PCB levels

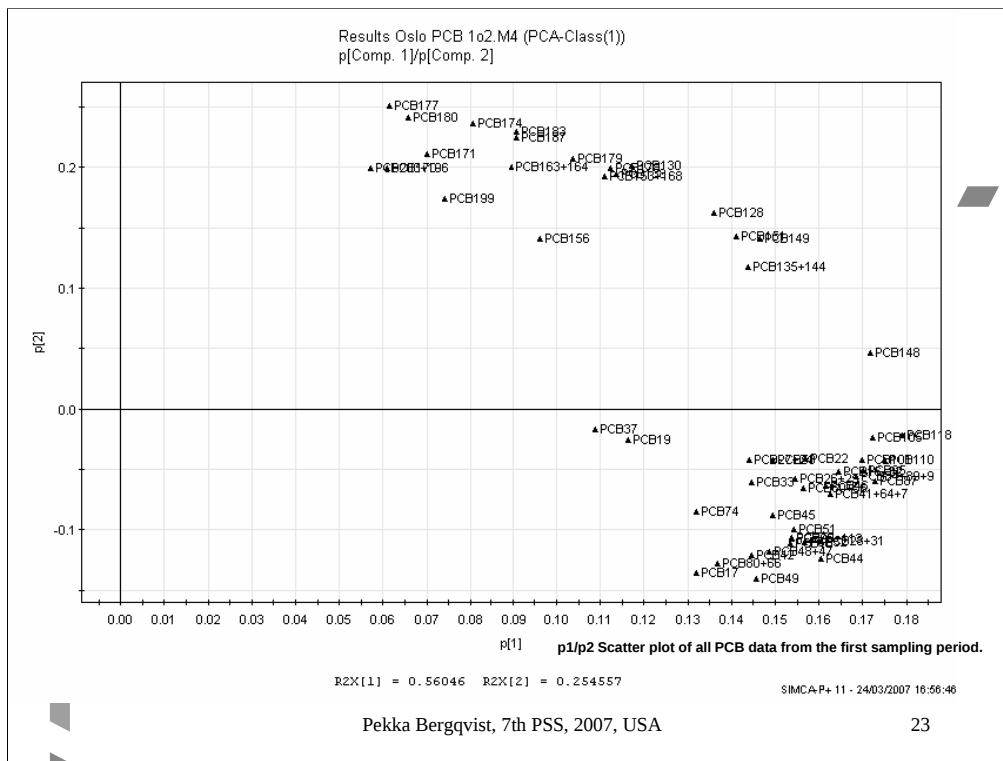
- 
- Levels highest at the bottom, but also 40 meter from bottom elevated levels compared to background site.
 - Levels decrease with distance from dumping area.
 - Distribution and levels confirmed with second sampling results.

PCB “finger printing”

- Principal component analysis (PCA)
- Normalized and centered data

In order to see the relationship between the different sampling sites PCA statistical method has been used.

By combining the results of the 79 different PCB congeners/“peaks” the similarities between the sampling sites can be tested.



PCB pattern

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- PCB pattern established at dredging site.
 - Similar PCB pattern at dredging site and dumping area.
 - Closest similarity with sites nearby dumping area.
 - “Diluting pattern” with distance from dumping area leading to the background pattern at site 16.
 - Additional source at site 13 and maybe 12.
Related to bottom source.

Metal sampled with DGT and water concentration calculated

- DGTs applied at same sites and depth as the SPMDs
- Results still to be evaluated.

Al, Ag, Ba, Ca, Cd, Ce, Co, Cr,
Cu, Dy, Er, Eu, Fe, Gd, Ho,
La, Lu, Mg, Mn, Nd, Ni, Pb, Pr,
Sm, Sr, Tb, Tm, U, Yb, Zn

The investigation has so far shown that:

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- Elevated levels of PCBs are found outside the dumping area.
 - The levels decrease with the distance from the dumping area.
 - Elevated levels of PCB are found from bottom up to 40 meters above sea bottom close to the dumping area.
 - The PCB “fingerprint” close to dumping area resembles the pattern that was identified in Oslo harbor close to the excavating activities. Samples taken close to dumping area showed the closest agreement.
 - This report is the first in a series describing different compounds spreading around the Malmøkalven dumping area.

Acknowledgement

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- NGO Neptun for funding.
 - Fishermen in the area for trying to guard the sampling equipment.
 - Norwegian Oceanographic institute for sampling probe.
 - Analysis by National lab for POP analysis in Ostrava, AnalyCen and Analytica.
 - Ecovision nord for GIS-presentations.

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