

Global geochemical mapping
and the particle bound flux
of major world rivers

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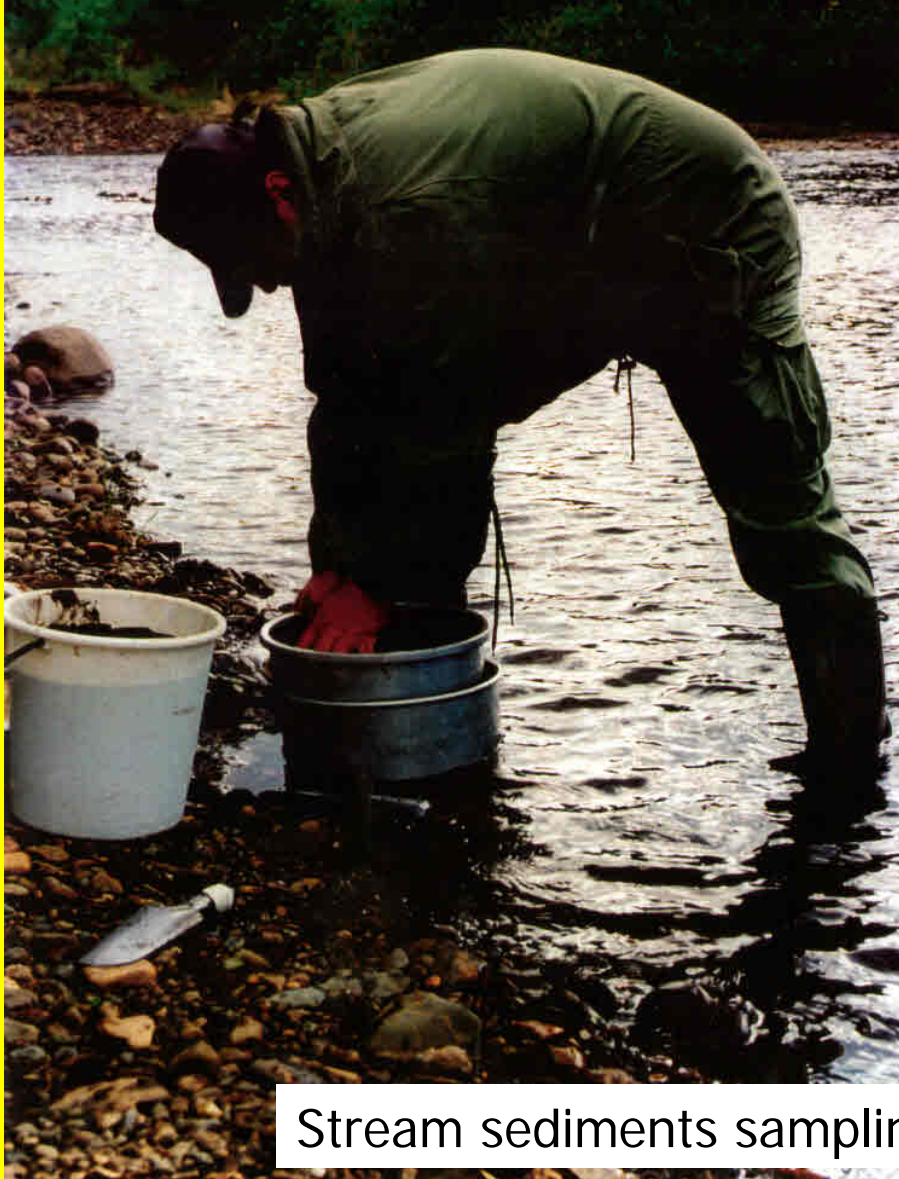


Topics for the talk

- Applied geochemistry and sediments
- Overbank sediment method for geochemical mapping
- Results from continental geochemical mapping
- PCB sources and particle bound flux of PCBs in the Arctic



Geochemists from Geological Surveys and mining companies all over the world collect fluvial sediments for exploration purposes



Stream sediments sampling: 1 – 4 samples / km²

Problem: Develop a method for mapping large areas with few samples?



10000 or more samples in small areas

Dynamics of drainage basins

Norwegian Water Resources and Energy Directorate and
Geological Survey of Norway

- Sediment sources
- Sediment transport and sedimentation
- Representativity of overbank sediments for a drainage system



Sediment sources



Sediment source: A stream undercuts an adjacent slope

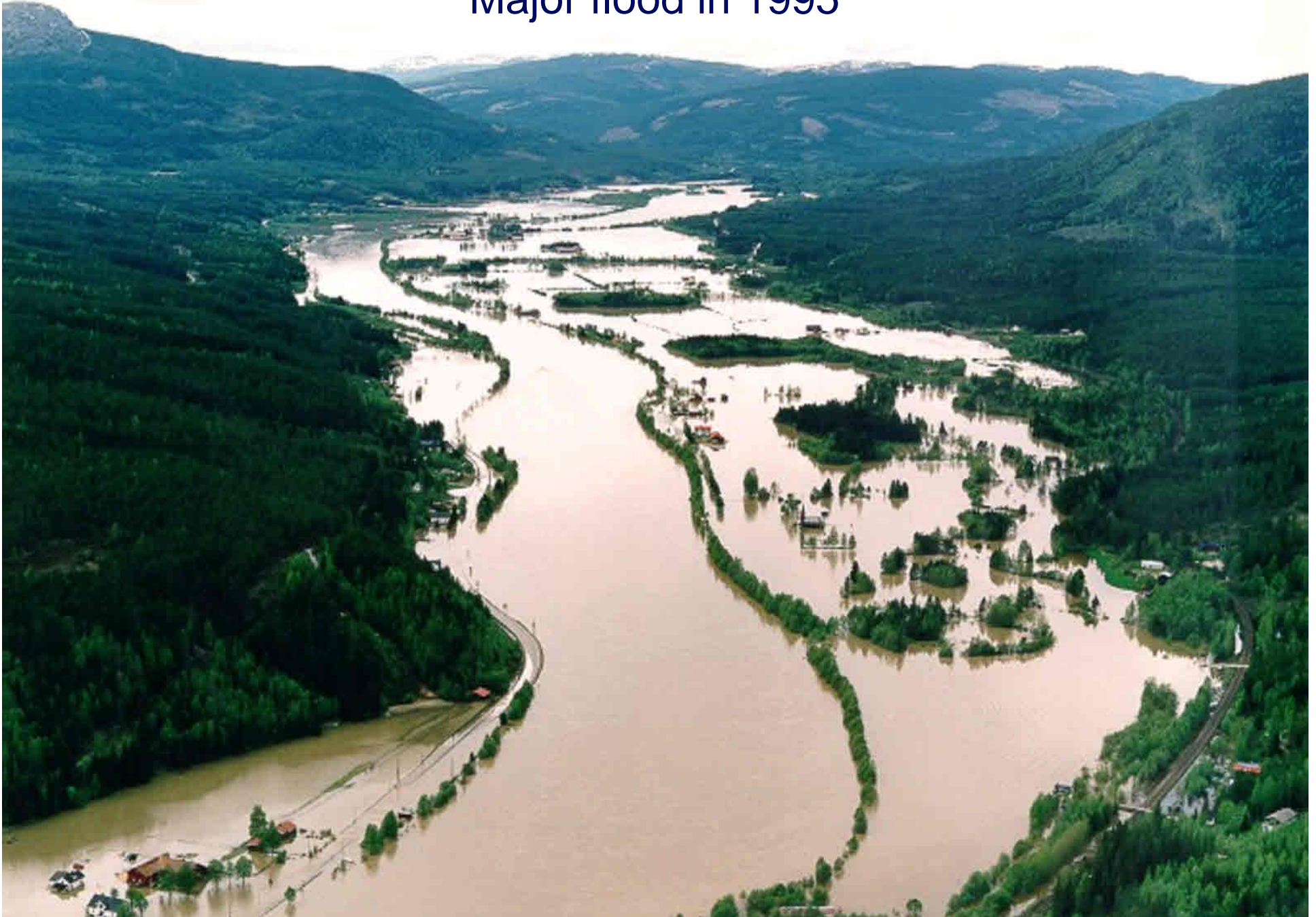
Major sediment source for tens of km

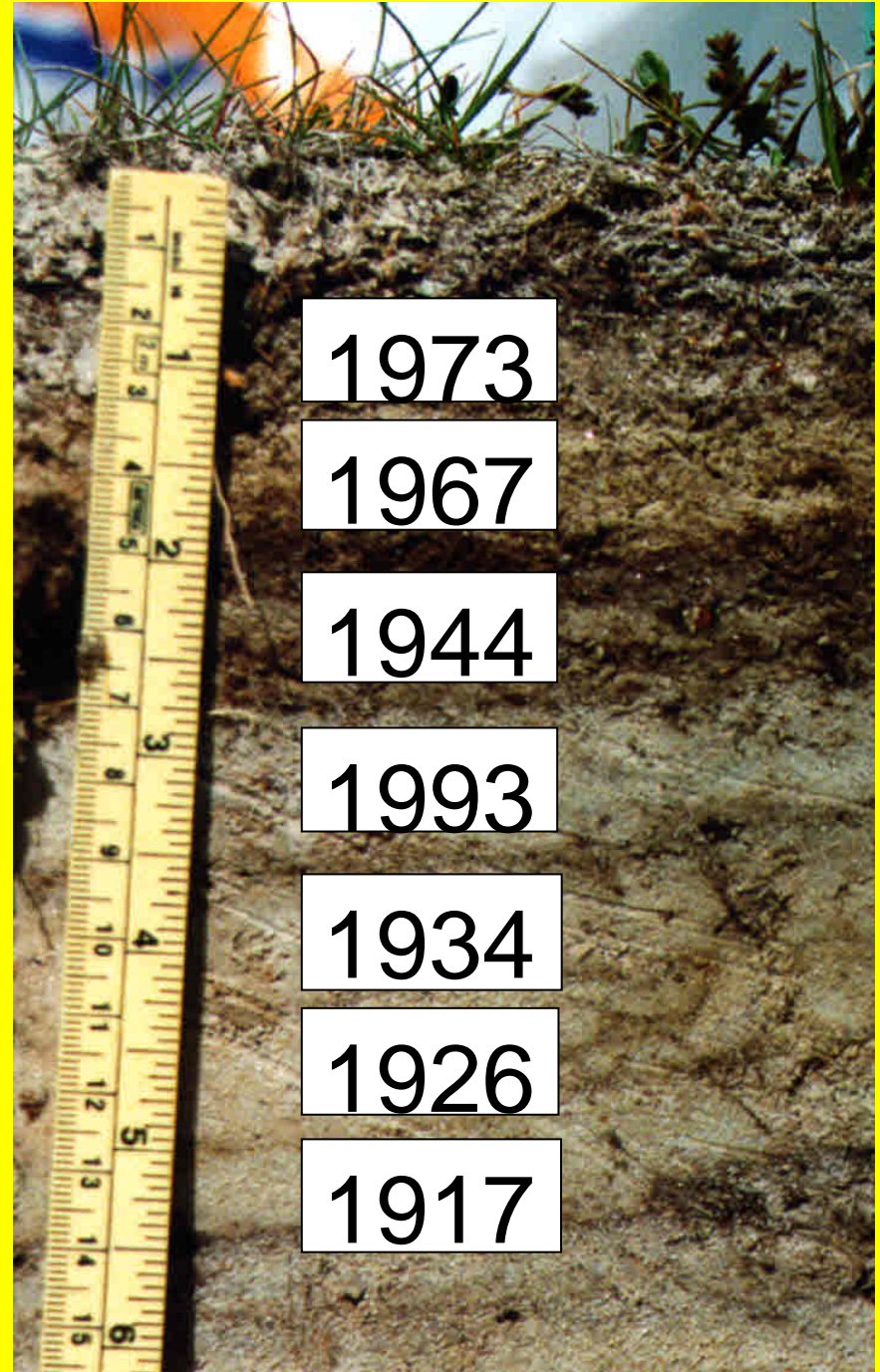


Important sediment source: Historical mine waste



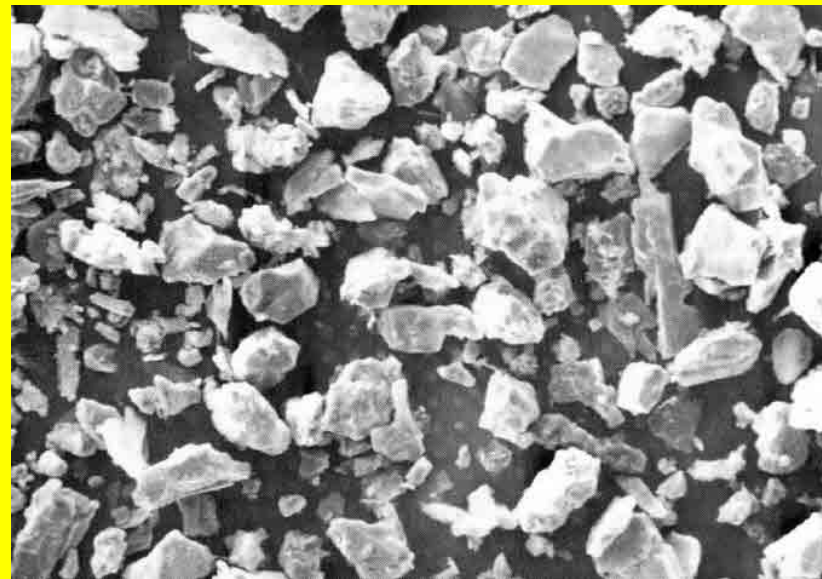
Major flood in 1995



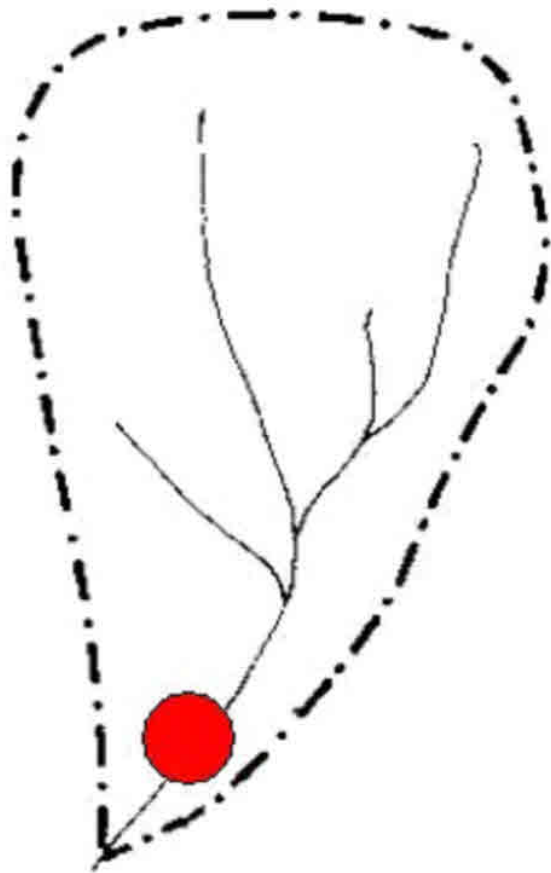


Overbank sediment

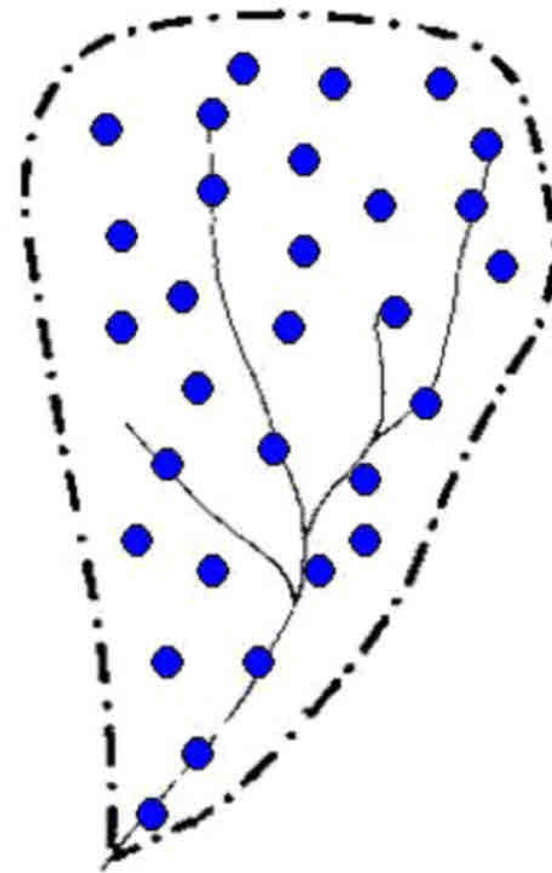
- Dominated by minerogenic material (silt/fine sand fraction $< 150\mu\text{m}$)
- Small amount of organic matter, normally in specific layers
- Fe-Mn hydroxides are normally not present
- Very poor – if any – soil development



Test for representativity



OVERBANK SEDIMENT



STREAM SEDIMENT

Overbank sediment – a smart sample medium due to natural processes

- The sediment suspended during floods has a widespread origin
- A composite sample through a vertical section of a overbank represents a large number of sediment sources that have been active at different times and forms an intergrated sample of the entire catchment areas

Test basin

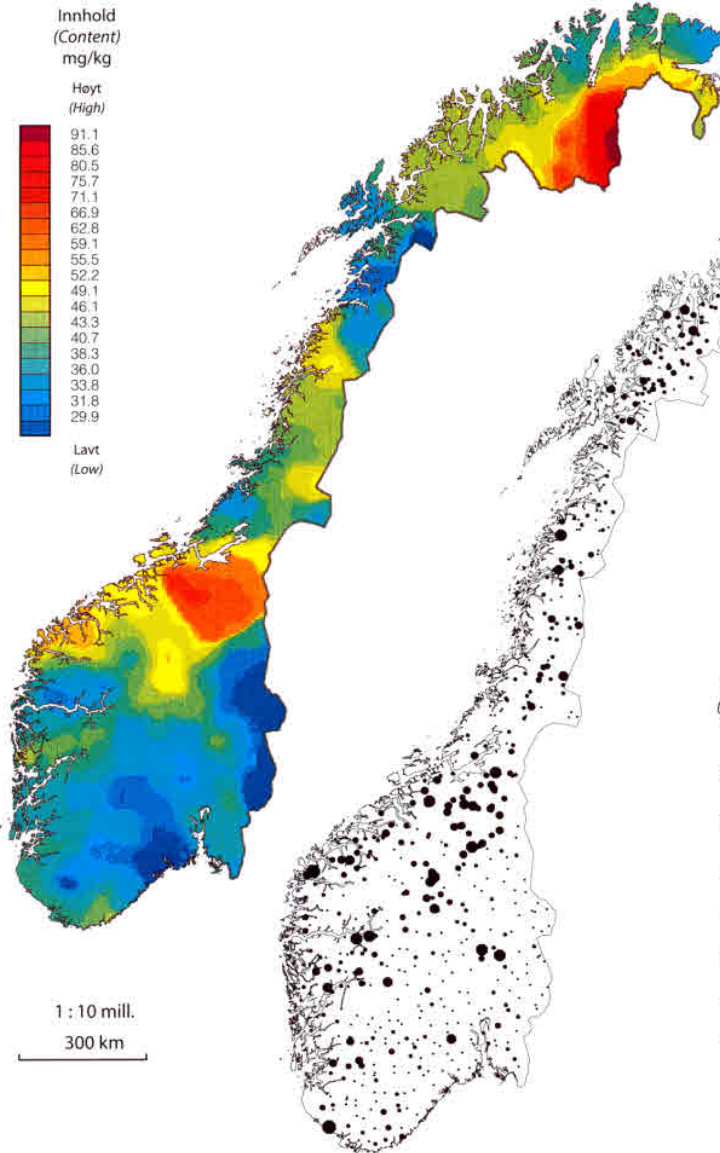


Boulders containing Molybdenite

Nikkel i flomsedimenter

Totalinnhold

(Nickel in overbank sediments: Total content)



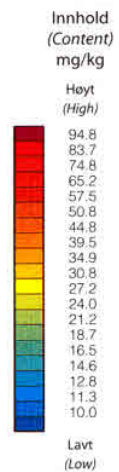
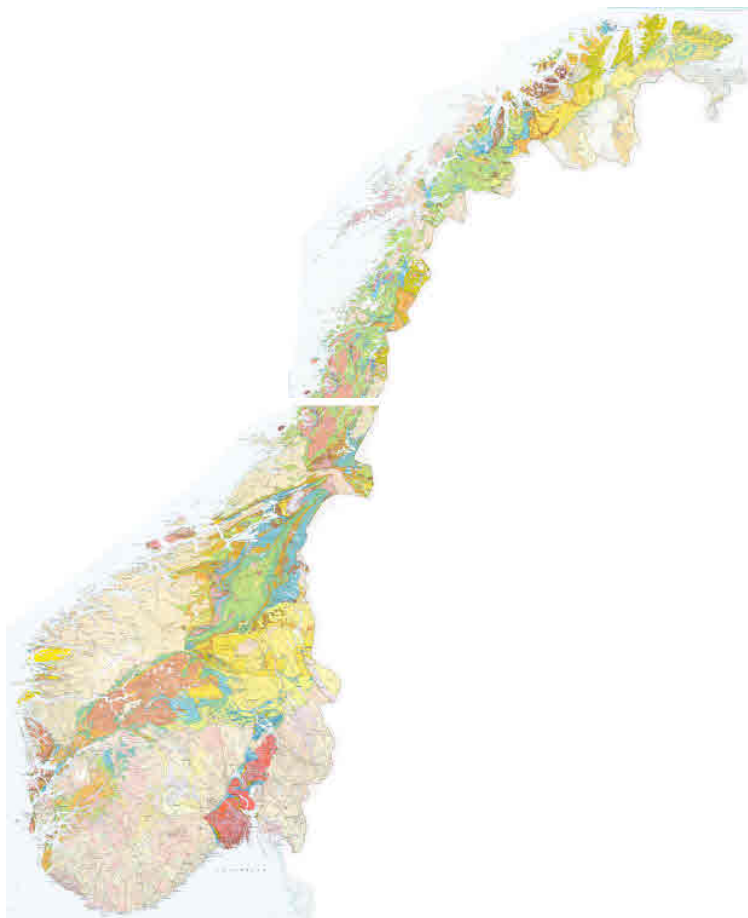
Innhold (Content) mg/kg

- > 130
- ≤ 130
- ≤ 100
- ≤ 81
- ≤ 63
- ≤ 51
- ≤ 39

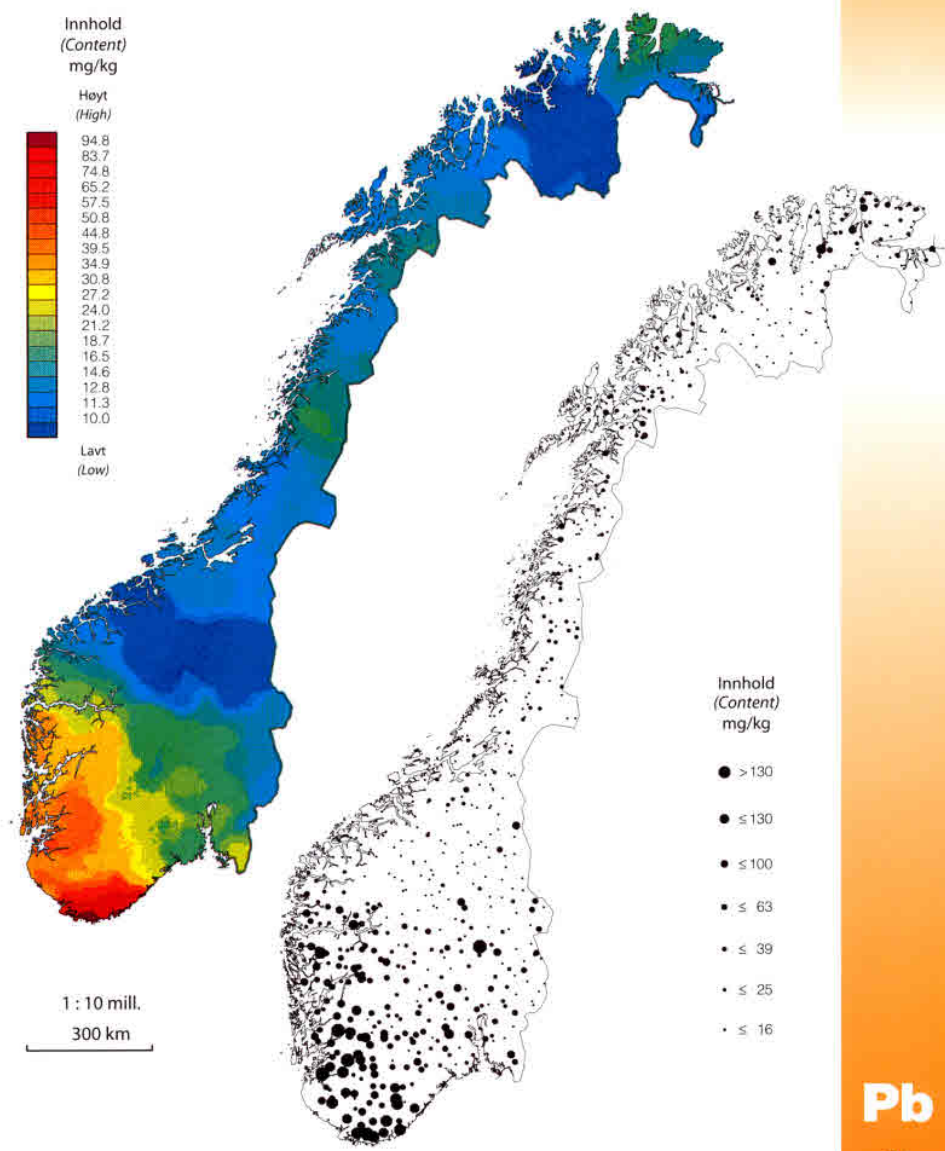
Bly i flomsedimenter

Syreløselig del

(Lead in overbank sediments: Acid-soluble part)



1 : 10 mill.
300 km



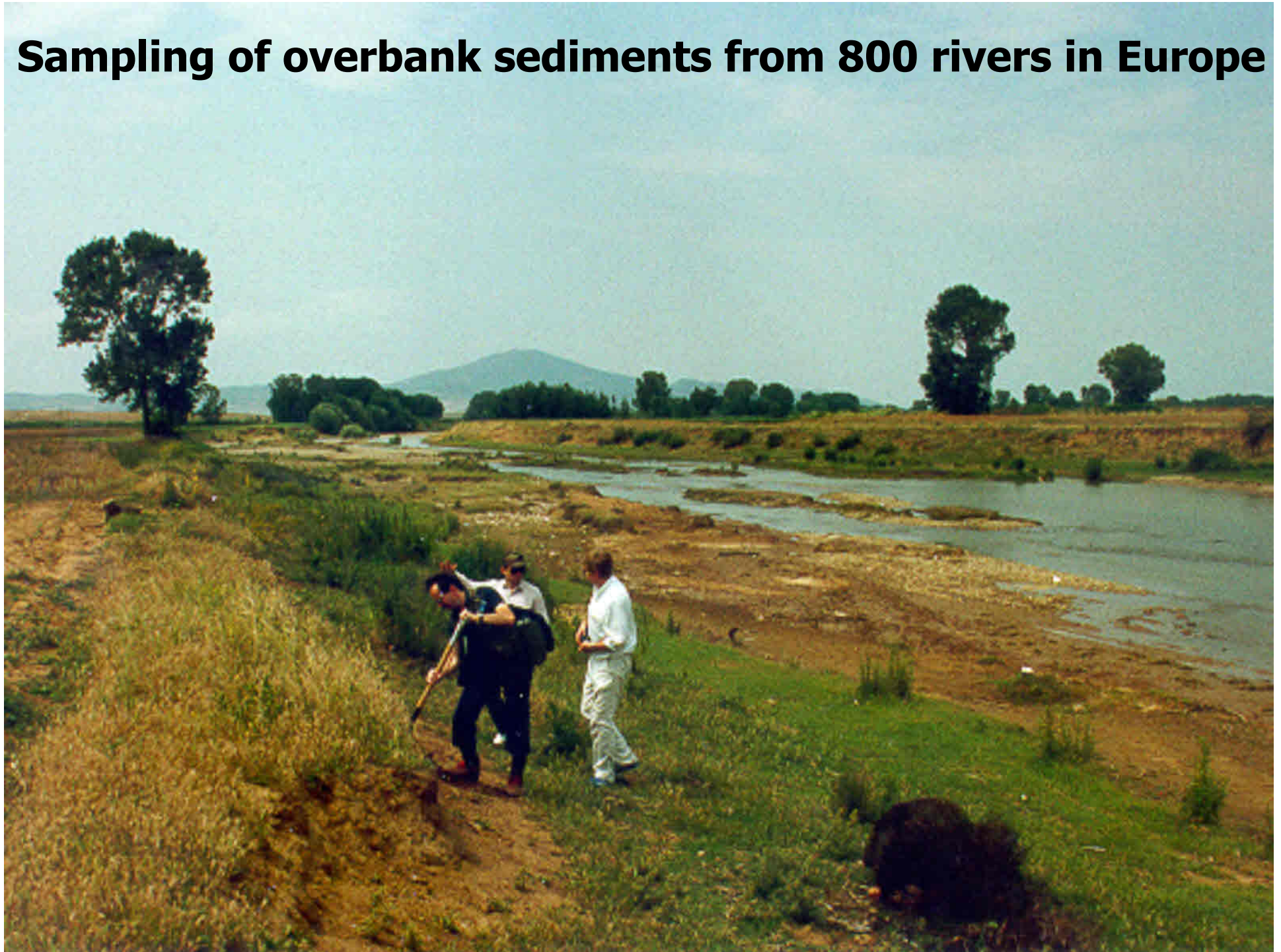
Pb

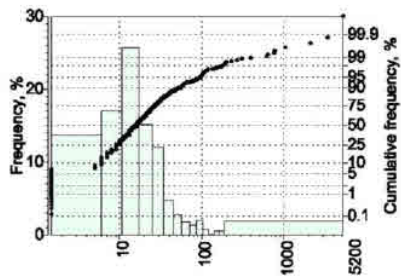
An aerial photograph showing a wide, muddy river flowing through a green agricultural landscape. The river has overflowed its banks, flooding the surrounding fields. The fields are divided into irregular shapes by brown hedgerows. The water is a light brown color, contrasting with the vibrant green of the grass. In the background, a small town or village is visible, partially obscured by the floodwaters. The overall scene depicts a significant flooding event in a rural, agricultural area.

Introducing of the "overbank sediment method" to Europe

- A large portion of the global population live on floodplains
- Floodplains are important farm land
- Floodplains are often drinking water reservoirs

Sampling of overbank sediments from 800 rivers in Europe



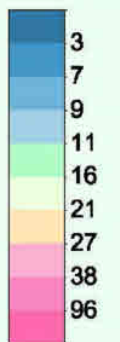


Lead Floodplain

Pb

0 500 1000 Kilometers

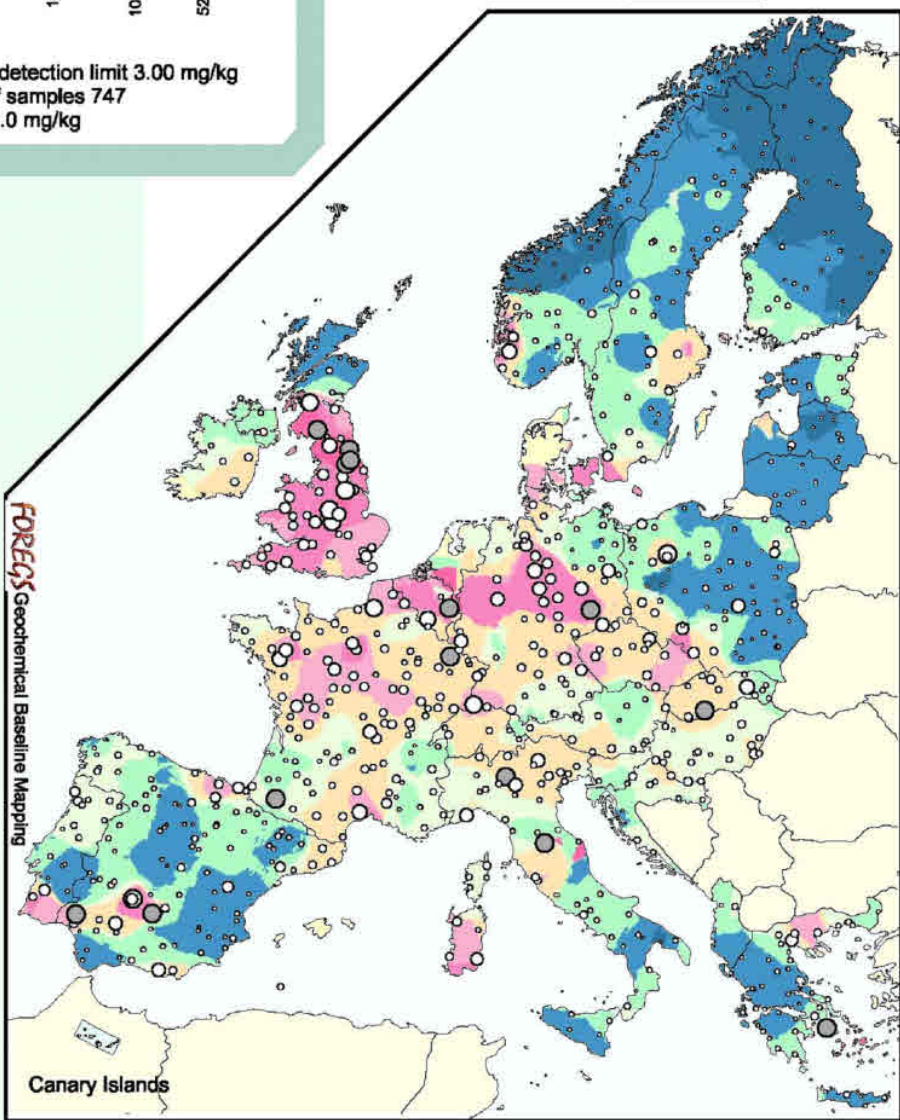
Pb
ICP-AES, detection limit 3.00 mg/kg
Number of samples 747
Median 16.0 mg/kg



Pb mg/kg



FOREGS Geotechnical Baseline Mapping

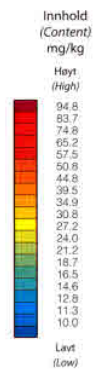


Canary Islands

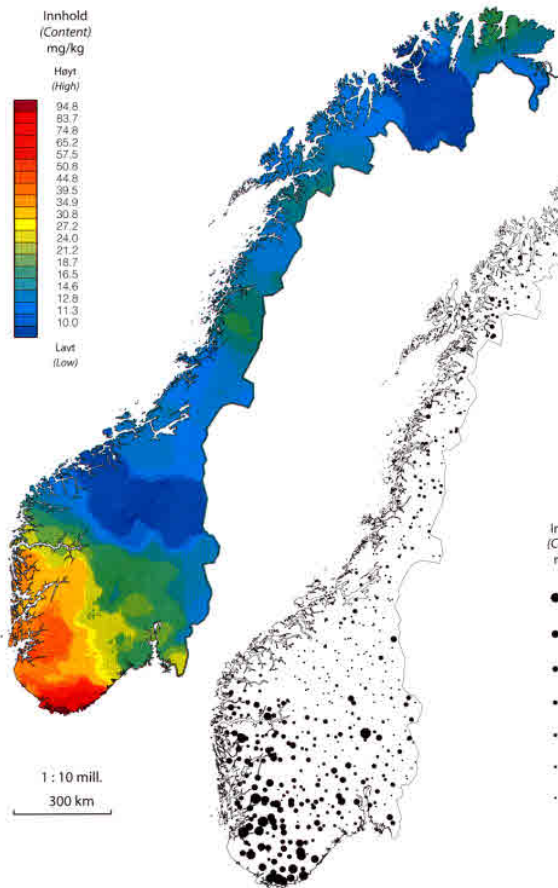
Bly i flomsedimenter

Syreløselig del

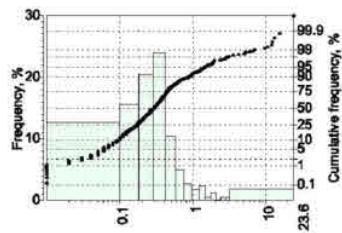
(Lead in overbank sediments: Acid-soluble part)



1 : 10 mill.
300 km



Pb

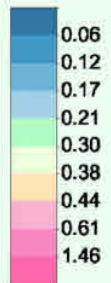


Cadmium Floodplain Cd



0 500 1000 Kilometers

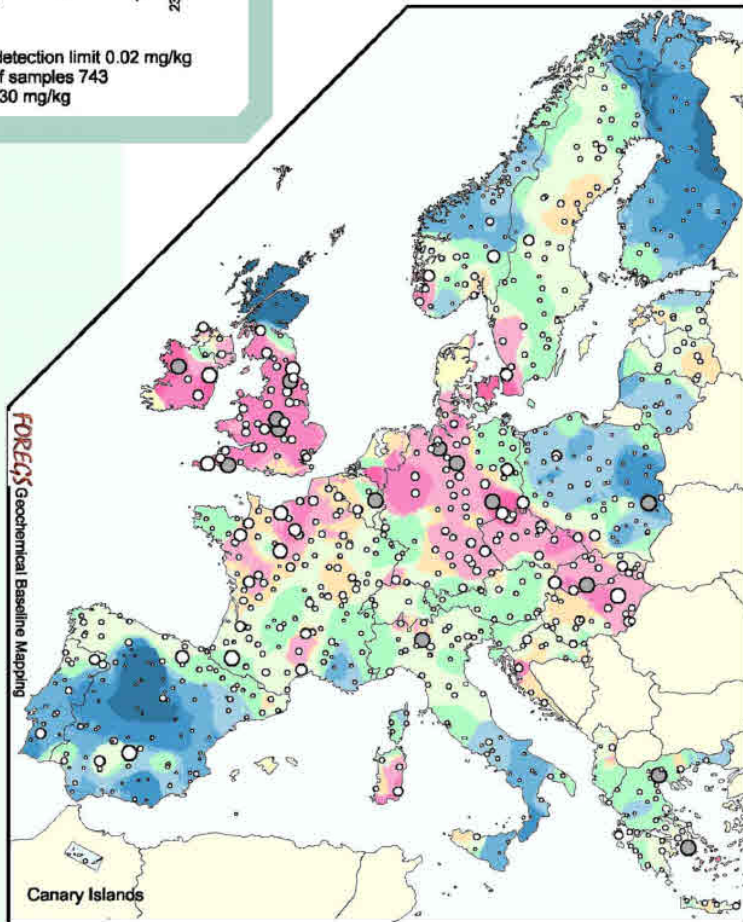
Cd
ICP-MS, detection limit 0.02 mg/kg
Number of samples 743
Median 0.30 mg/kg



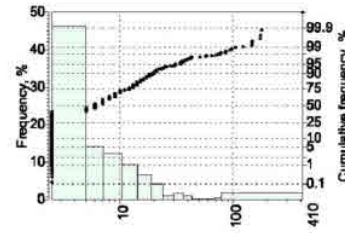
Cd mg/kg



FOREG's Geochemical Baseline Mapping



Canary Islands

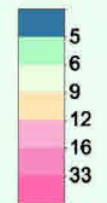


Arsenic Floodplain As

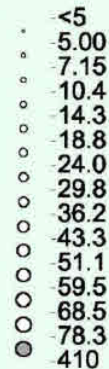


0 500 1000 Kilometers

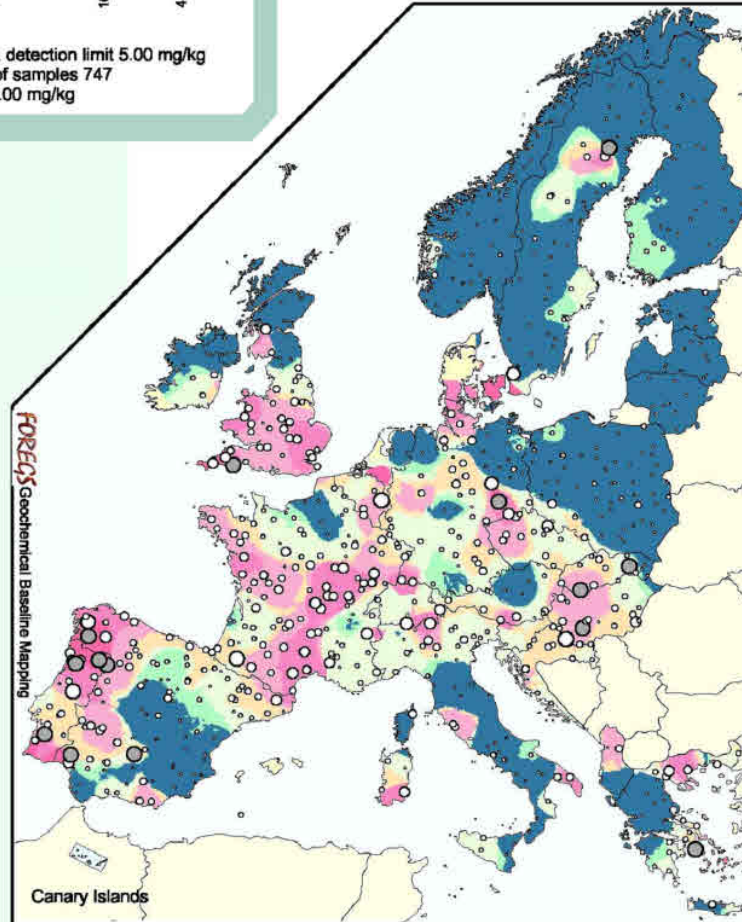
As
ICP-AES, detection limit 5.00 mg/kg
Number of samples 747
Median 6.00 mg/kg



As mg/kg



FOREG's Geochemical Baseline Mapping



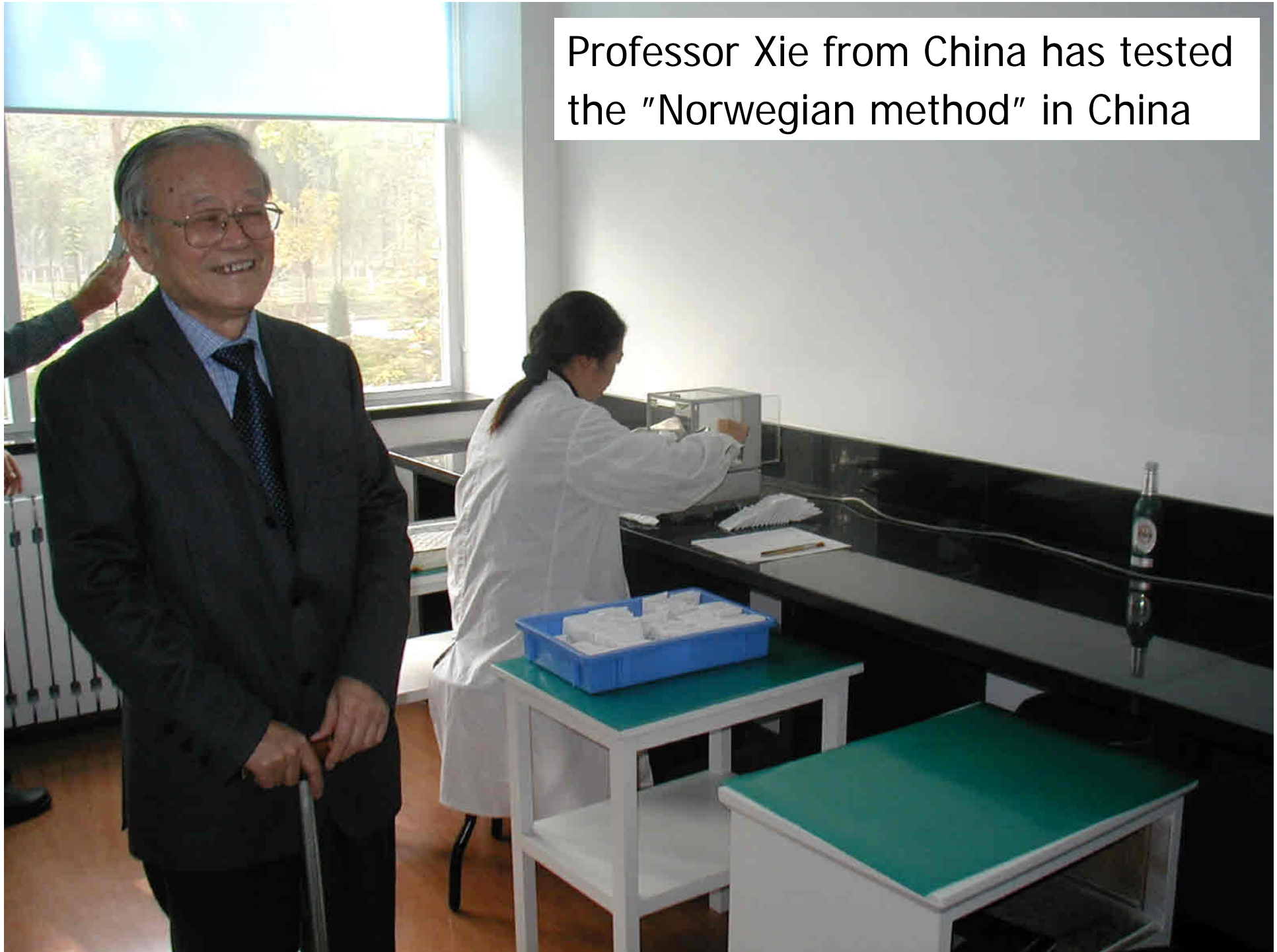
Canary Islands



35 % of the floodplains in Europe are polluted with historical mine waste



Professor Xie from China has tested the "Norwegian method" in China



Two field teams sampled China (10 million km²)
in two years



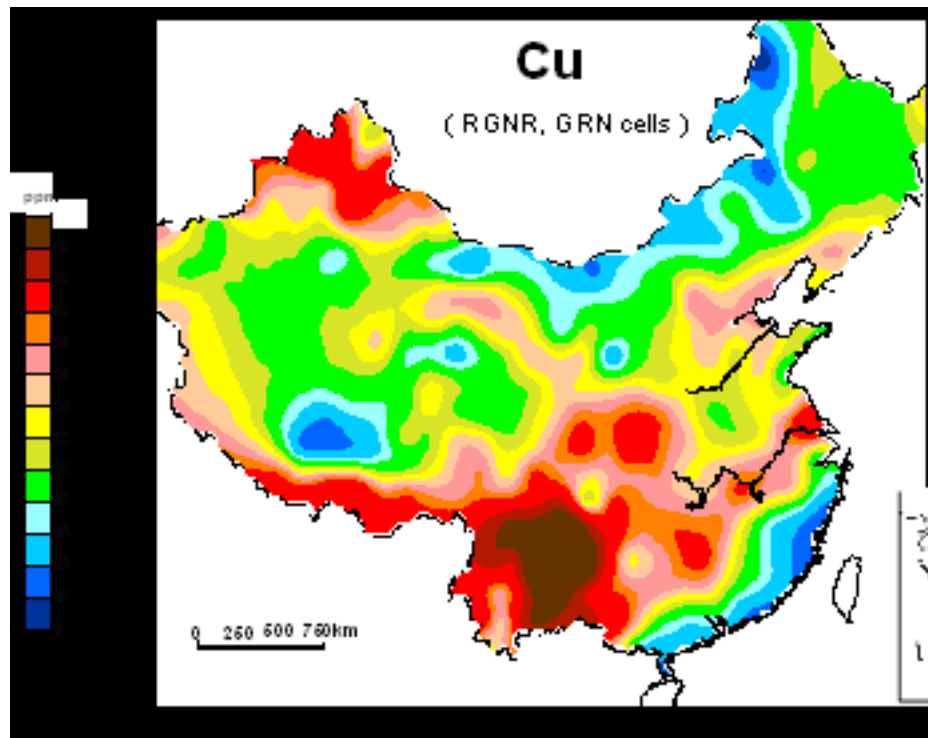
A photograph showing a soil profile. A wooden plank is laid horizontally across the top of the soil. A yellow measuring tape is placed vertically against the soil face, extending from the surface down to a depth of approximately 100 cm. The soil is dark brown and appears moist. Some roots are visible on the right side of the profile. The background shows a grassy area and the lower legs of a person wearing blue jeans.

Top sample 0-25 cm

Bottom sample 75 -100 cm

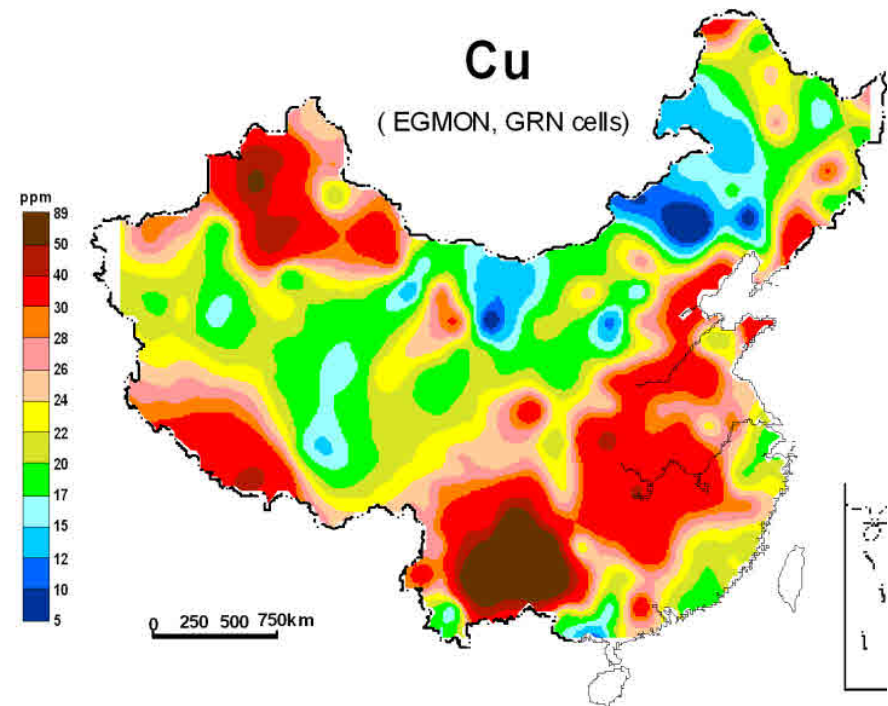
2004 10 21

The Geochemical Distribution of Cu in China



Stream sediment

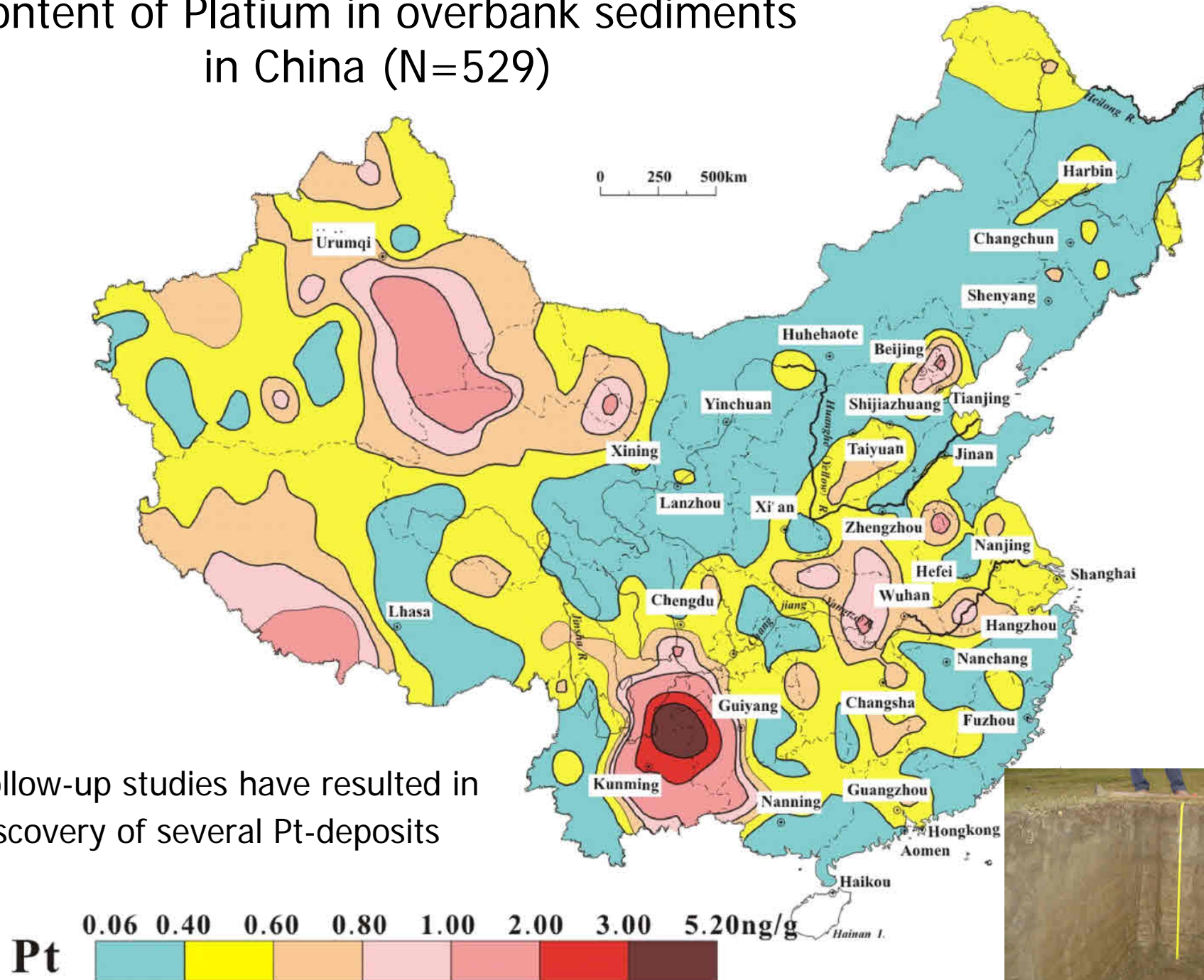
6 million samples



Overbank sediment

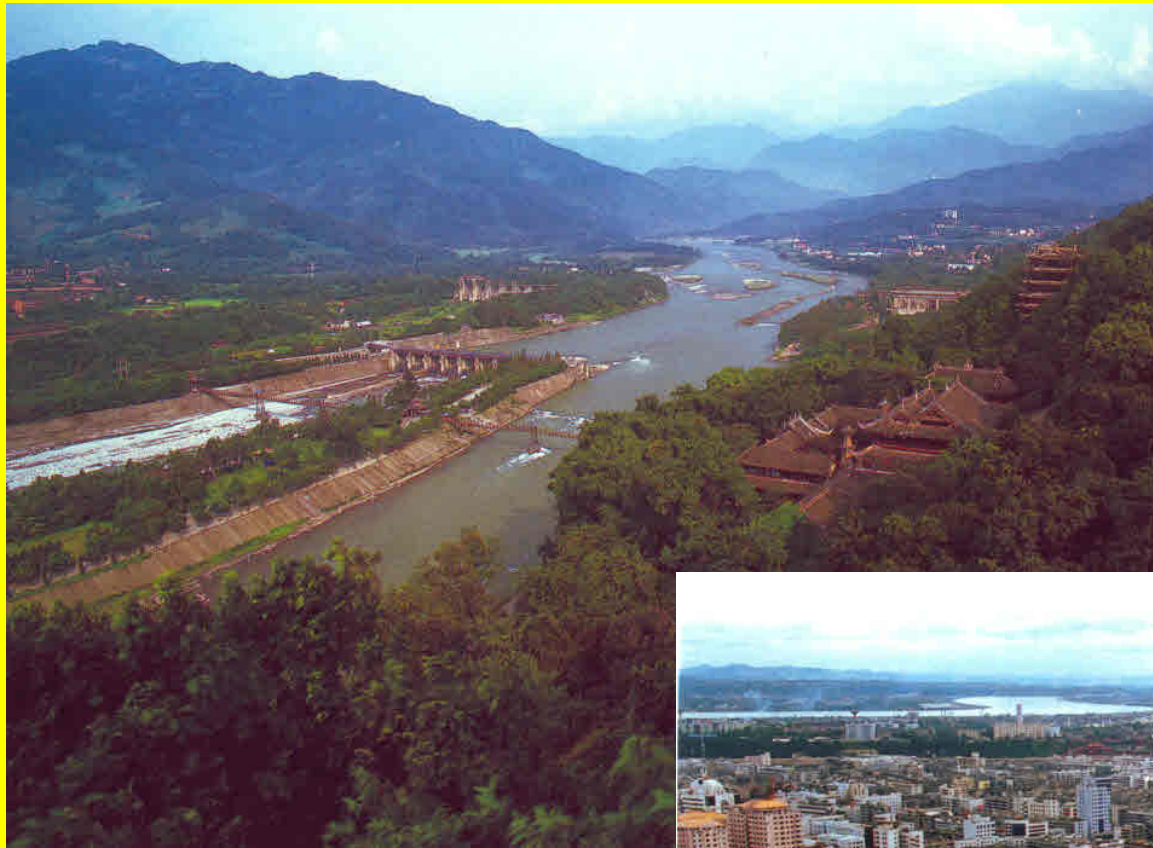
529 samples

Content of Platinum in overbank sediments in China (N=529)



Follow-up studies have resulted in discovery of several Pt-deposits

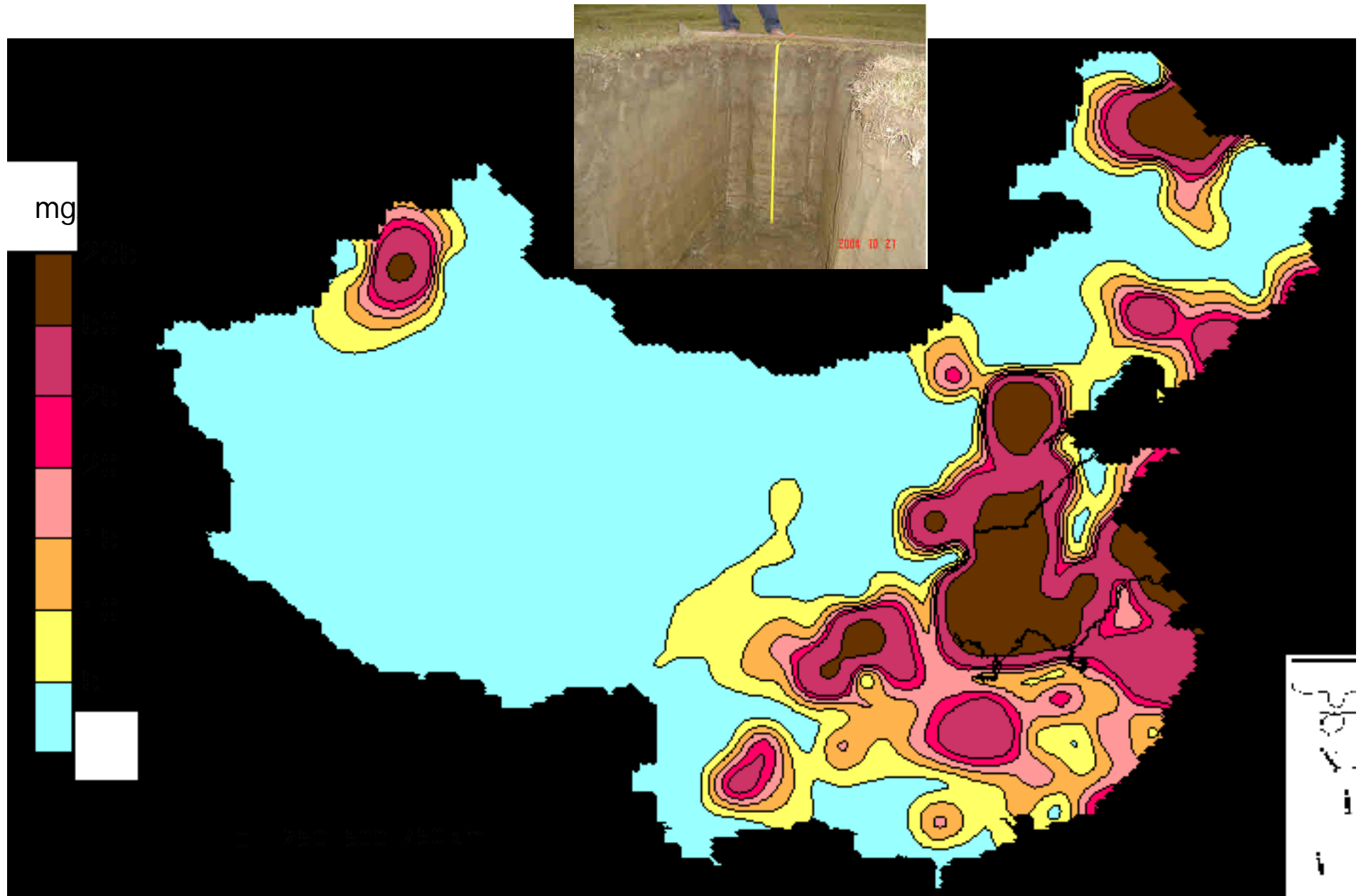




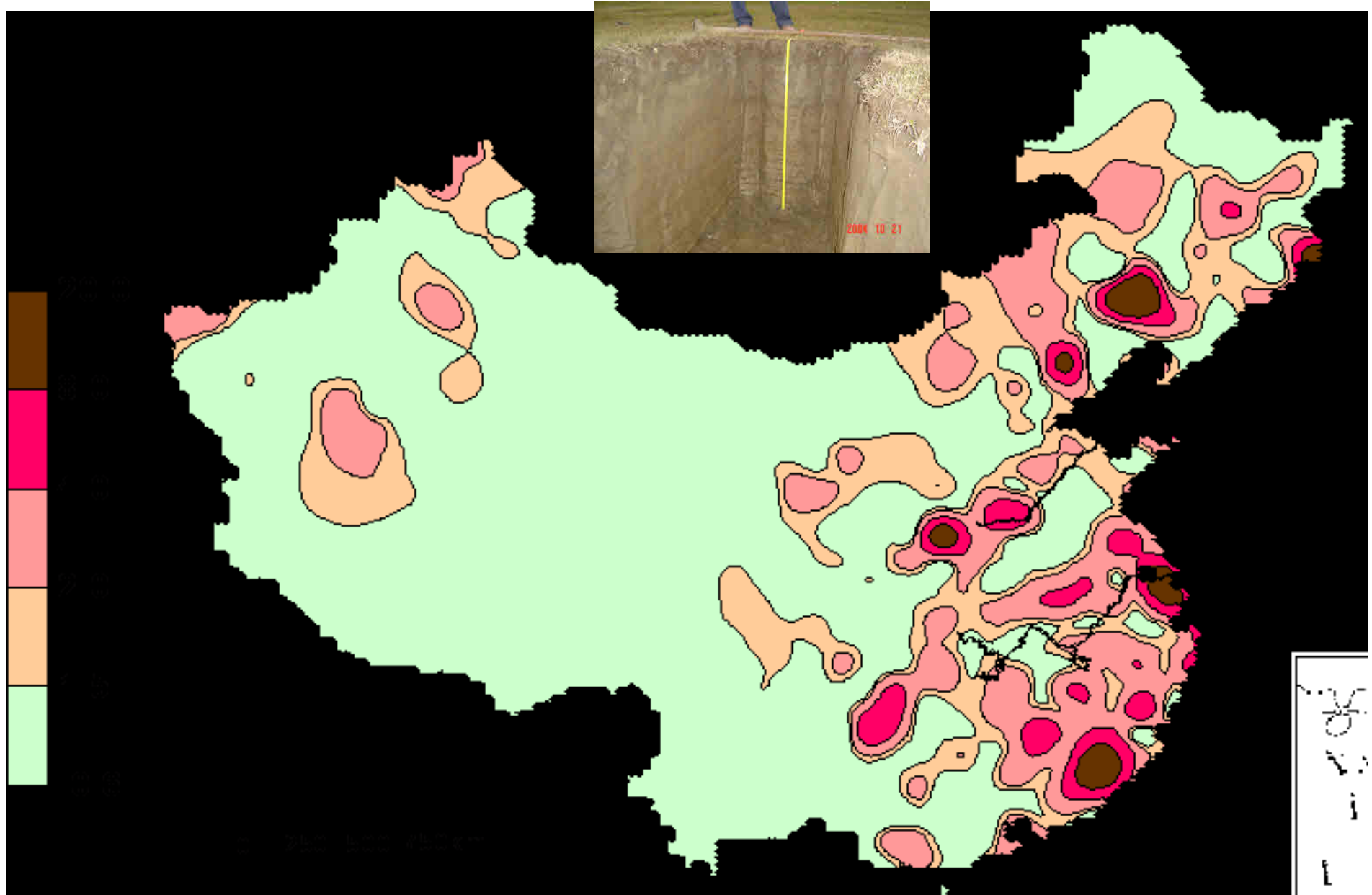
Rice fields with high concentrations of DDT and Cadmium

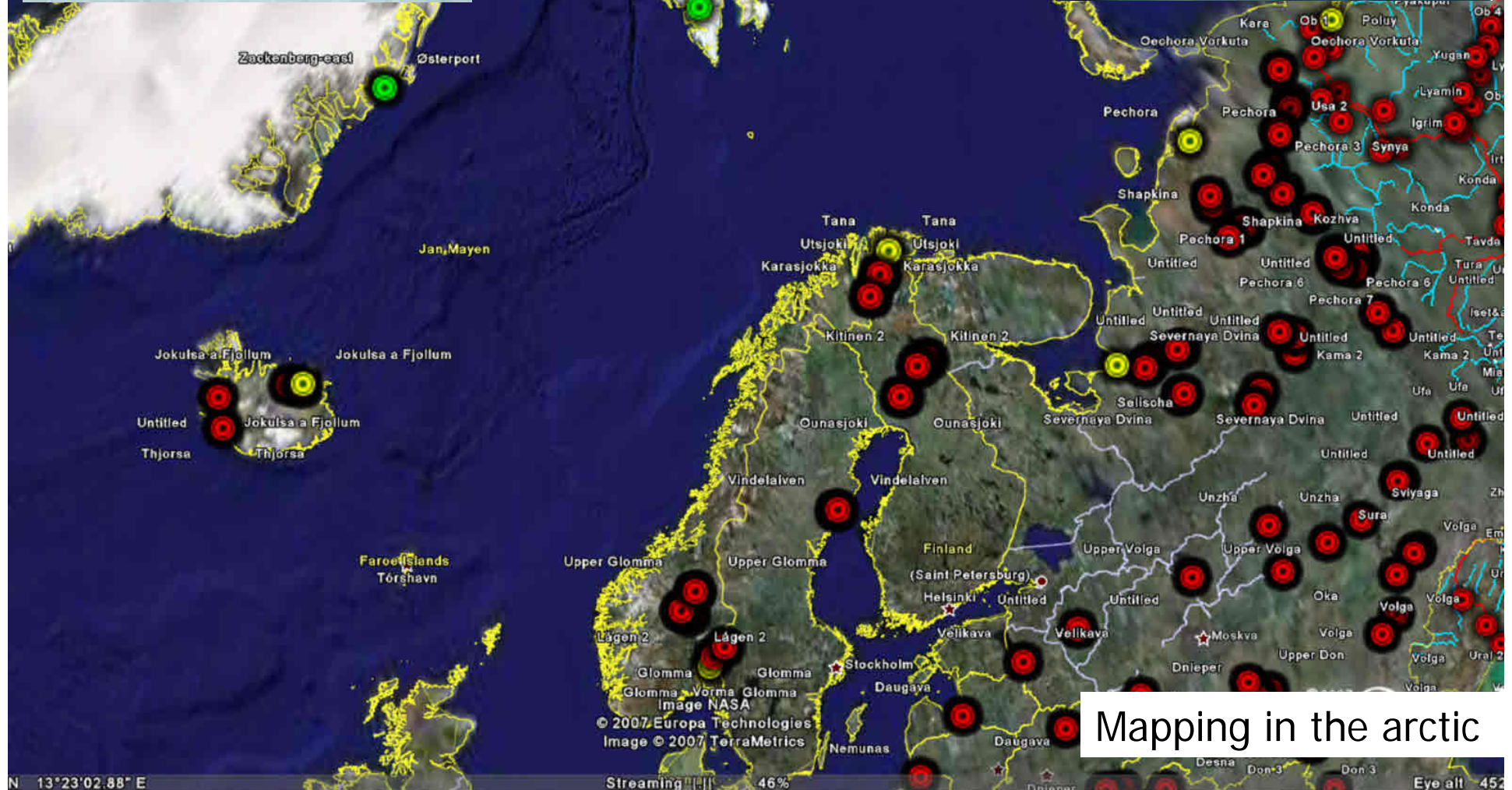
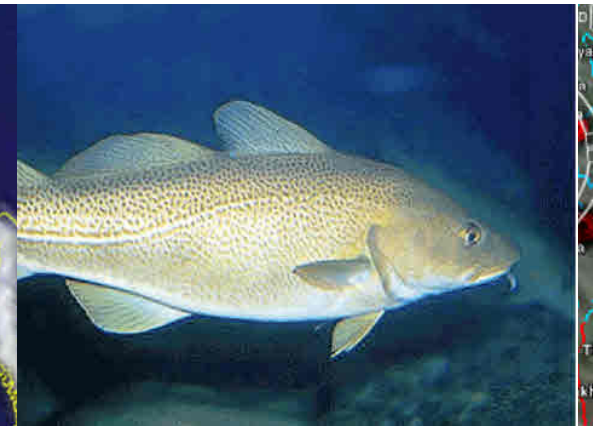


Content of DDT in the upper sample (N=529)

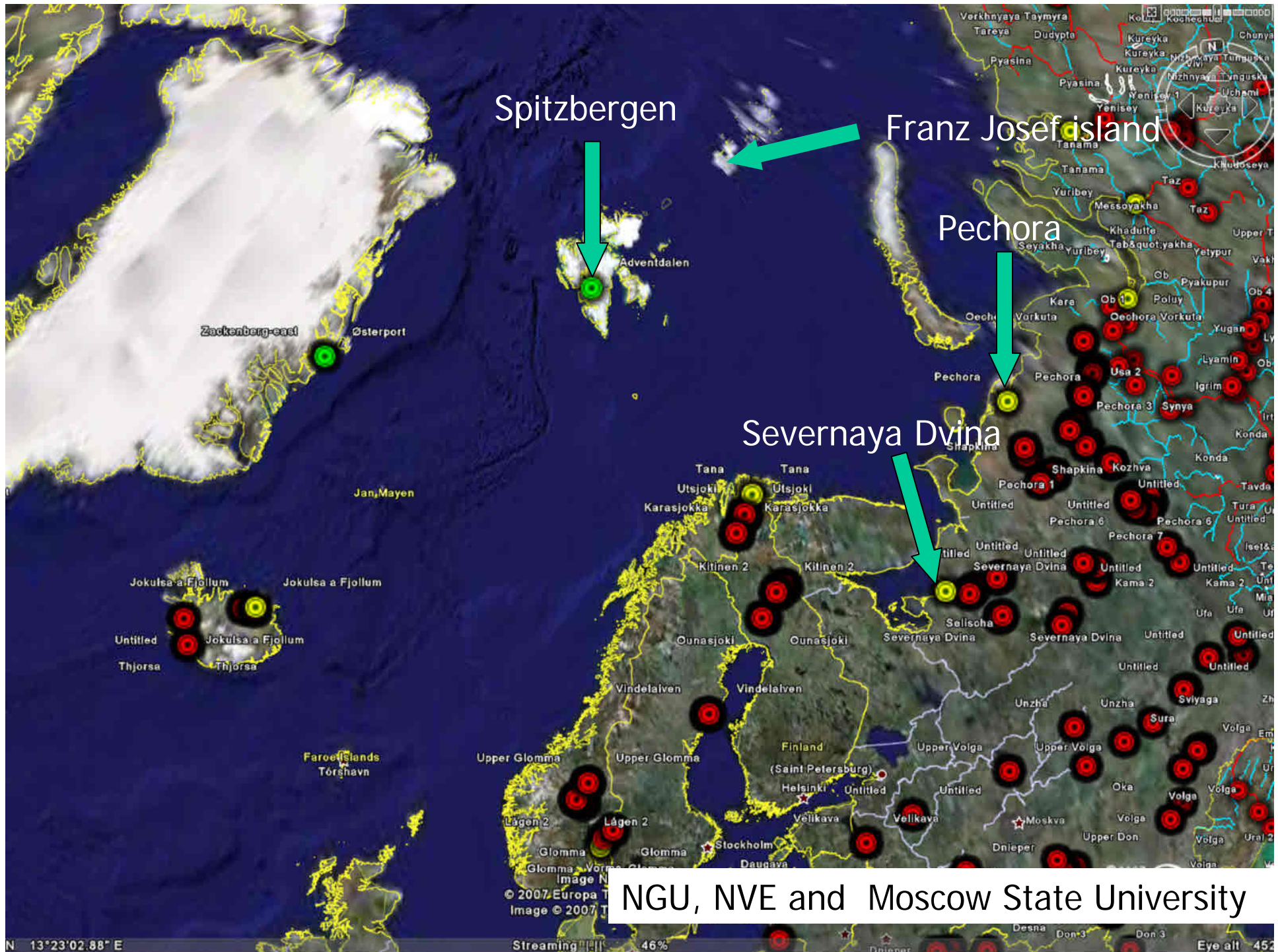


Mercury (Top) / Mercury (Bottom)



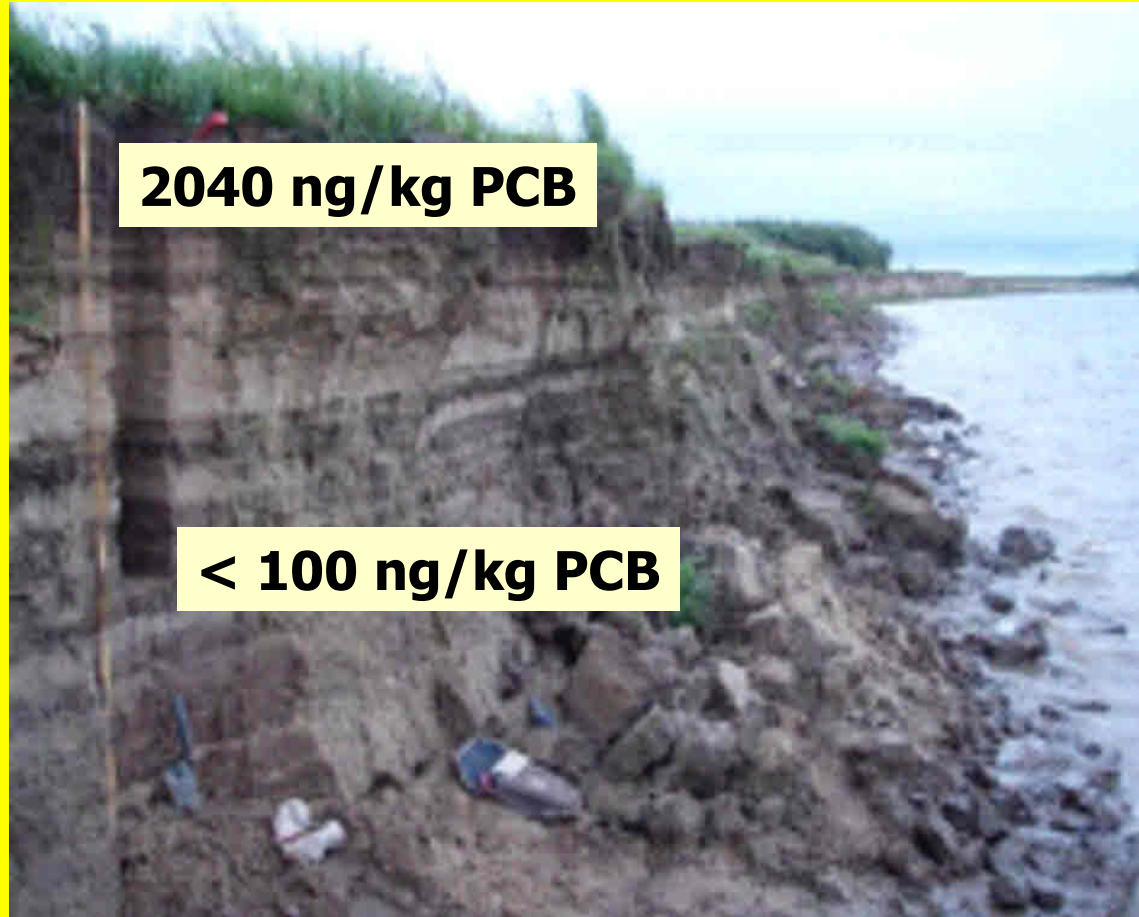


Mapping in the arctic





Content of PCB in overbank sediment from Severnaya Dvina

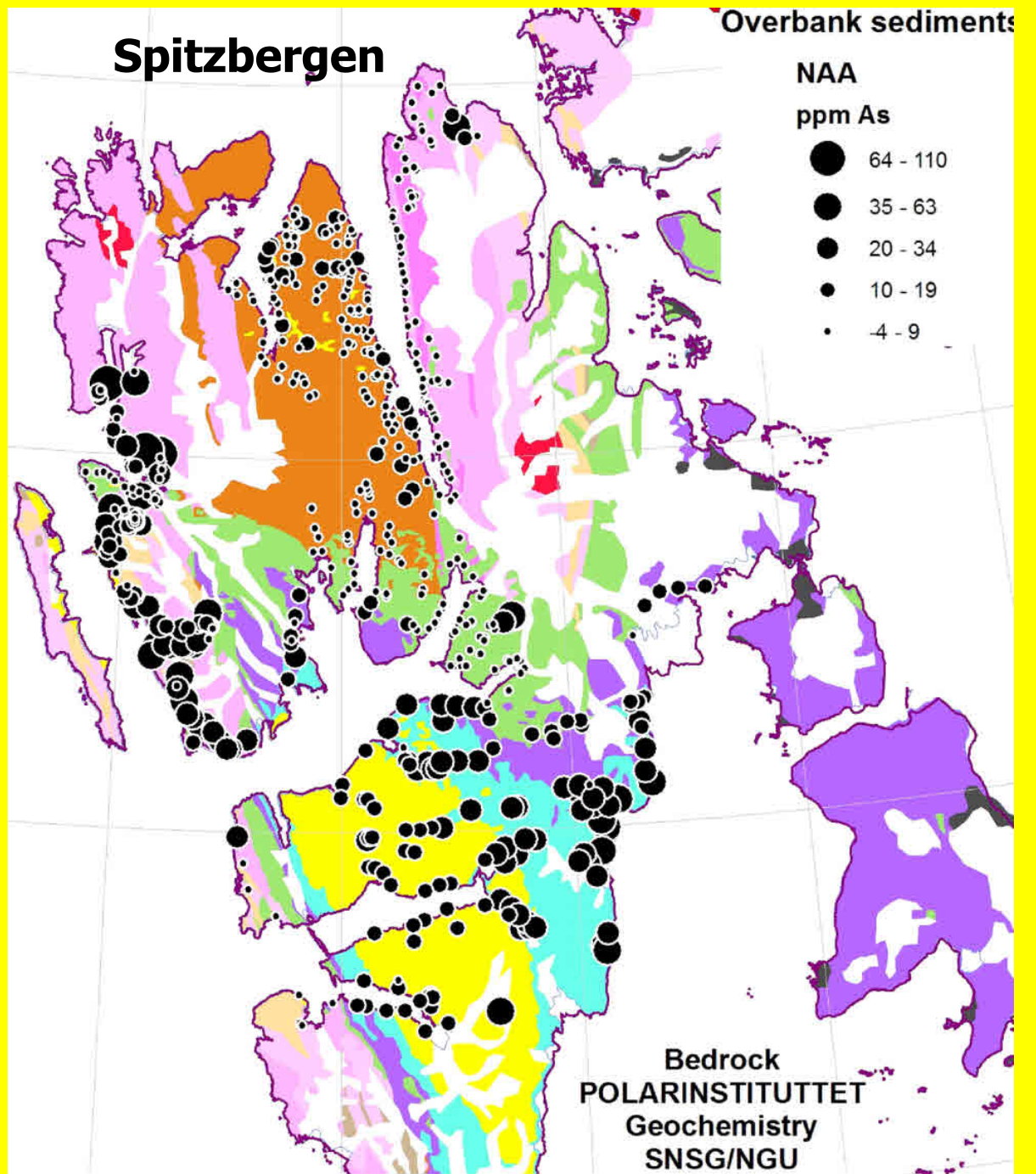


Flux of PCB from Pechora (A) and Severnaya Dvina (B)



Glacial river Adventelva, Svalbard, Norway



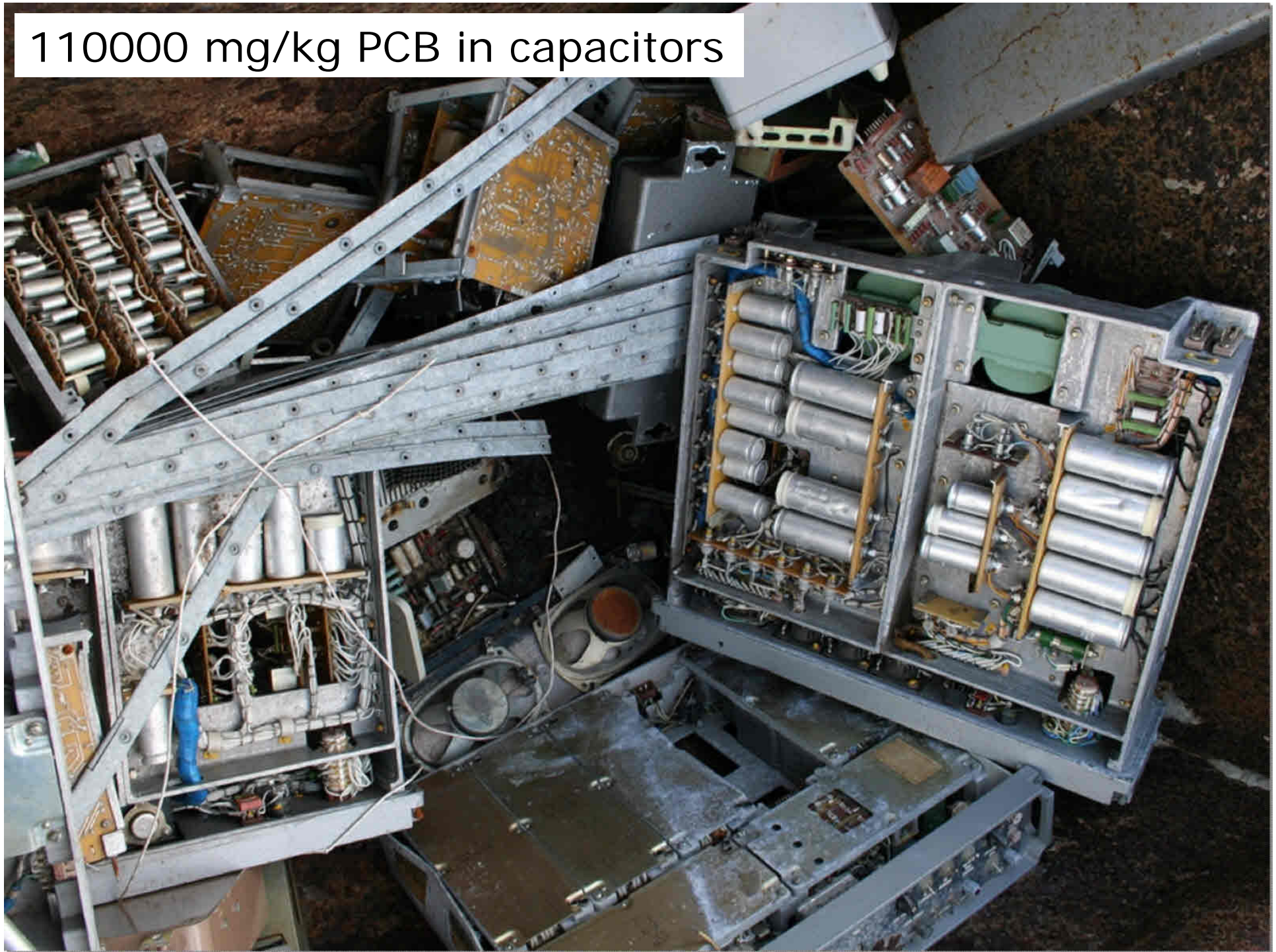


Coal-mine settlement in Spitzbergen





110000 mg/kg PCB in capacitors



PCB in paint, plaster and concrete in buildings from the coal mining settlements on Spitzbergen island





Active erosion and massive spreading of PCB-polluted soils and sediments in Barentsburg, Pyramiden and Longyearbyen



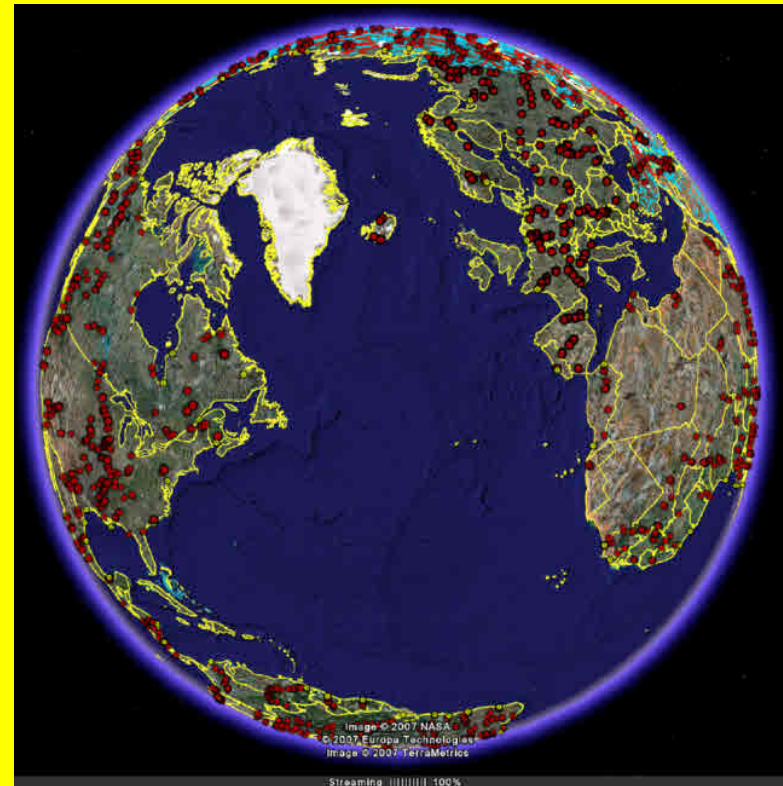
Estimated 2000 kg of PCB in soils from the Barentsburg settlement



www.globalgeochemistry.org

Information on the web-site:

- General project information
- Overbank sediments
- Delta sediments
- Porposed sample sites
- Sample protocols
- Contact persons
- Meetings



We are missing North and South America and Africa



Australia is currently being sampled

Image © 2007 TerraMetrics

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Thank you for your attention

