Sediment transport in Norwegian rivers and antropogenic impacts.

Case studies of importance to sediment management plans

1. Natural background sediment yields
2. Impact of hydropower development
3. Impact of erosion protection works
4. Long term dispersion of mine waste

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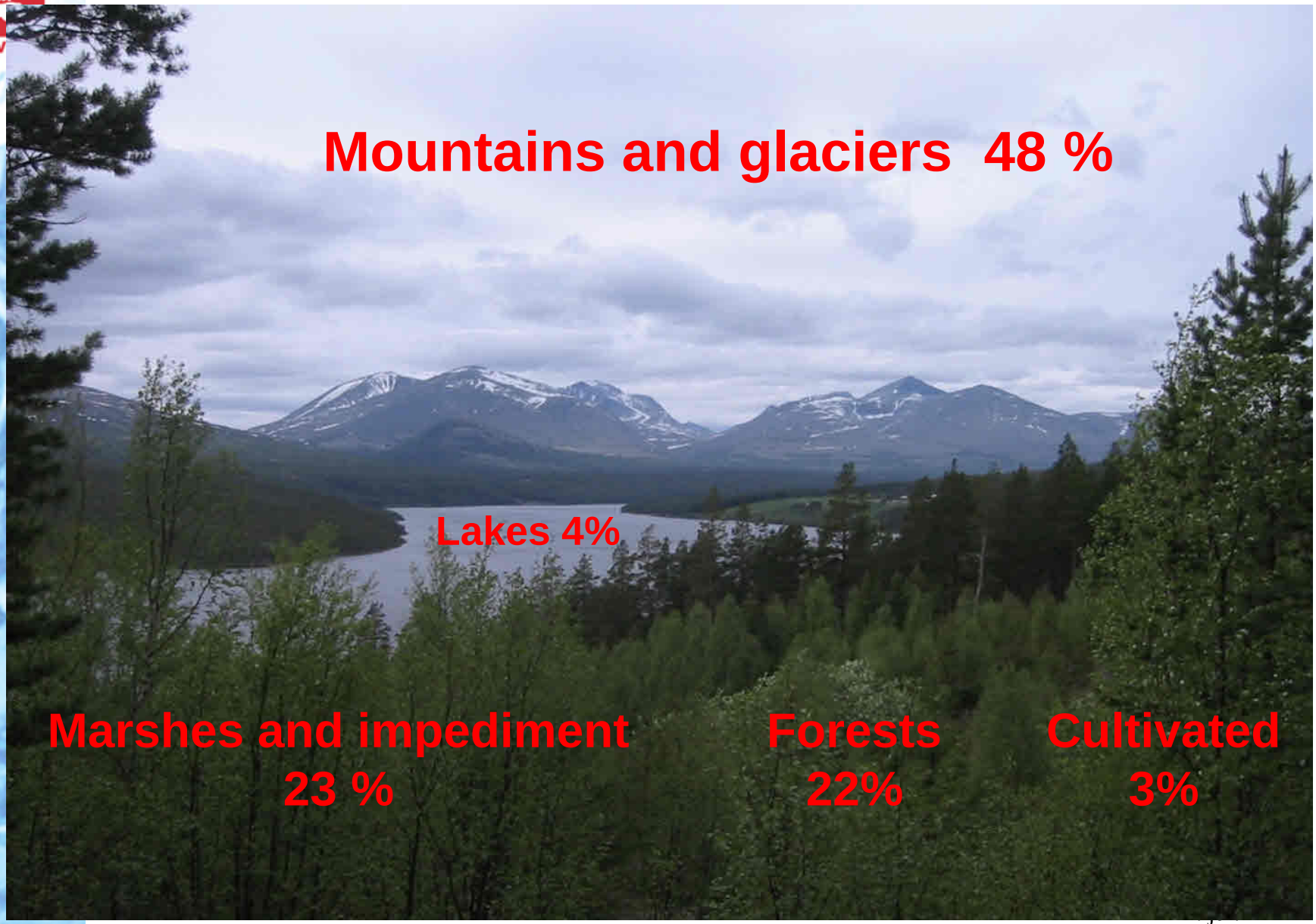
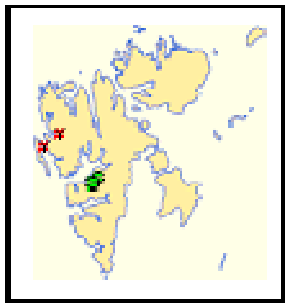
Norwegian Water Resources and Energy Directorate
Geological survey of Norway

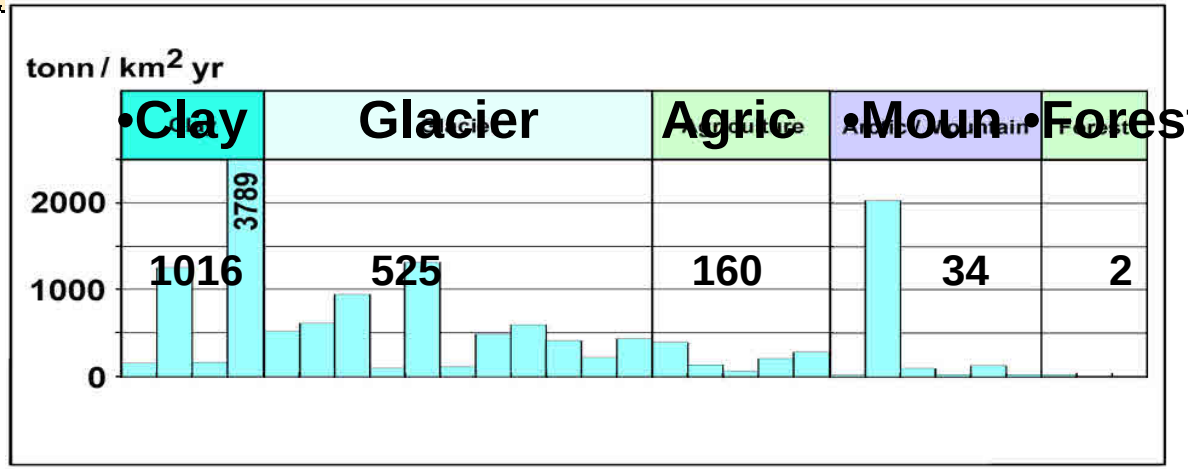
NORWAY AREA


Mountains and glaciers 48 %
Lakes 4%
Marshes and impediment 23 %
Forests 22%
Cultivated 3%

Sediment yield of Norwegian rivers

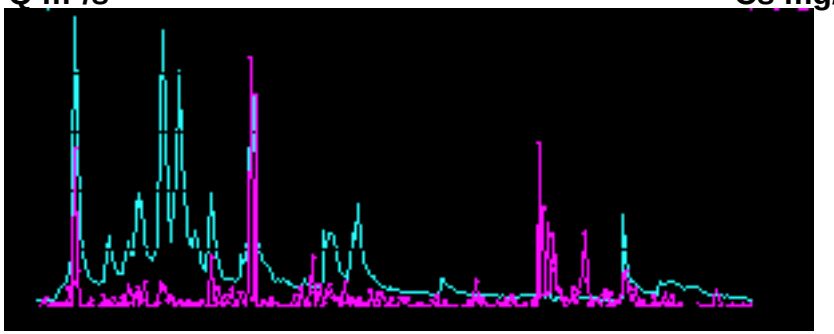


Spesific sediment yield of various source areas–

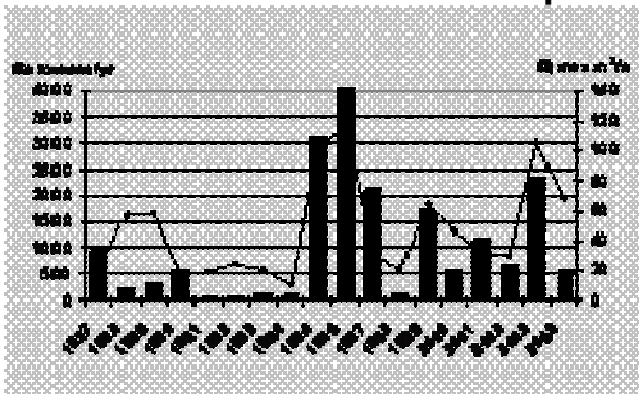


Selected example: river Atna :

Concentration and water discharge



Annual mean transport



Sediment transport Svartisen power plant
Rule of operation determine flux

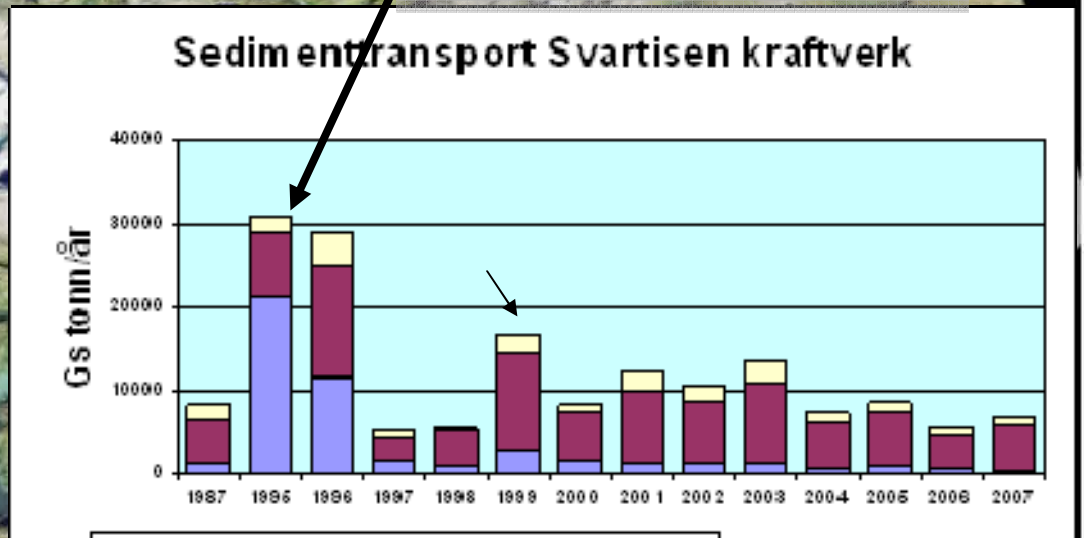
Sattelite image 1999

Svartisen power station

Storglomvatn - reservoir

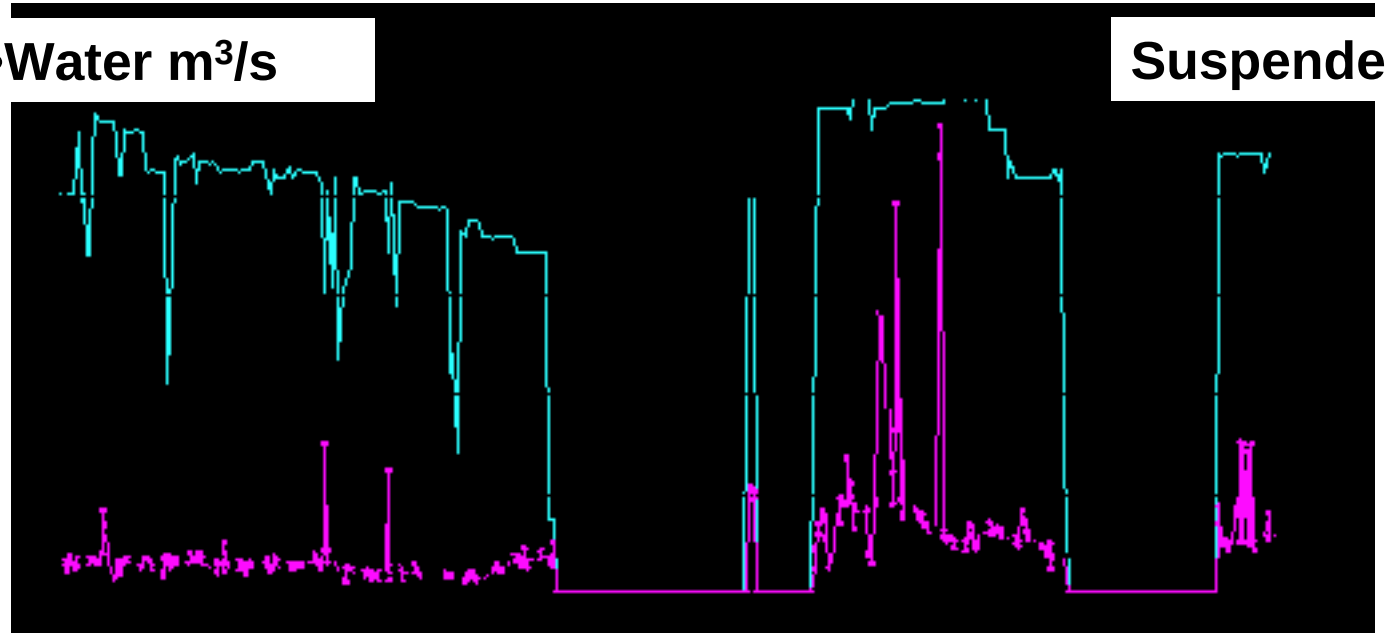
New generator 2008 – give more sediments

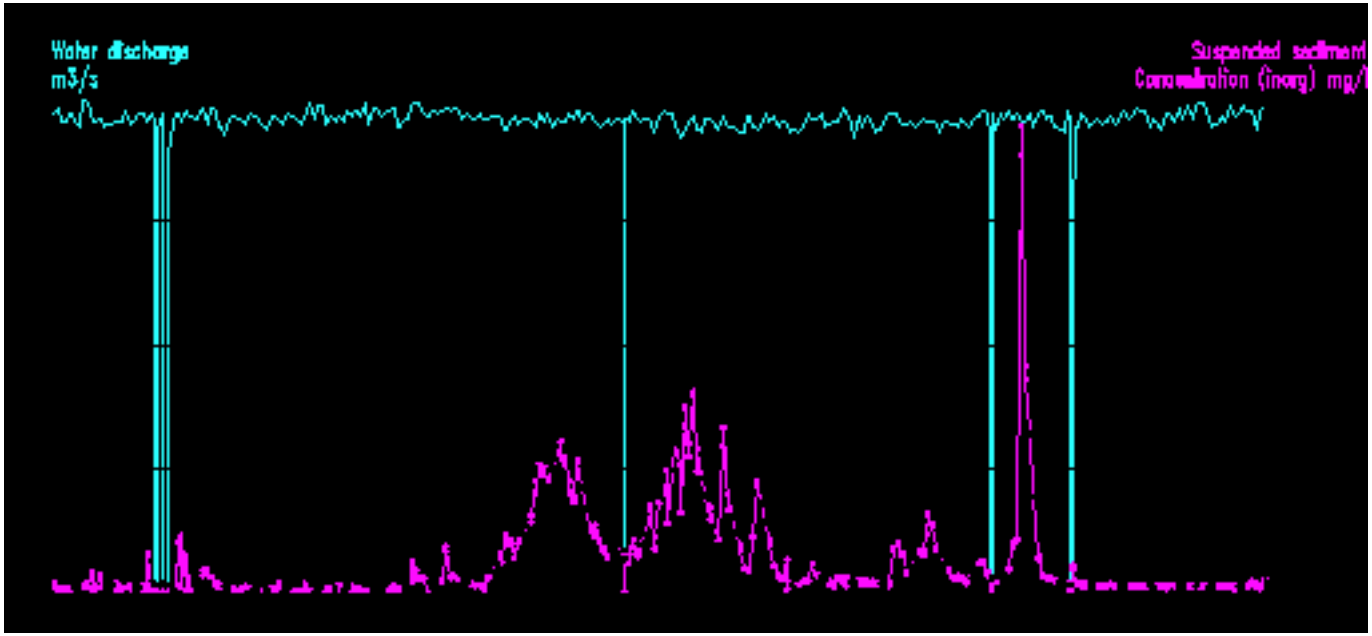
Construction of dam
Drawdown of reservoir



- Water m^3/s

Suspended mg/l

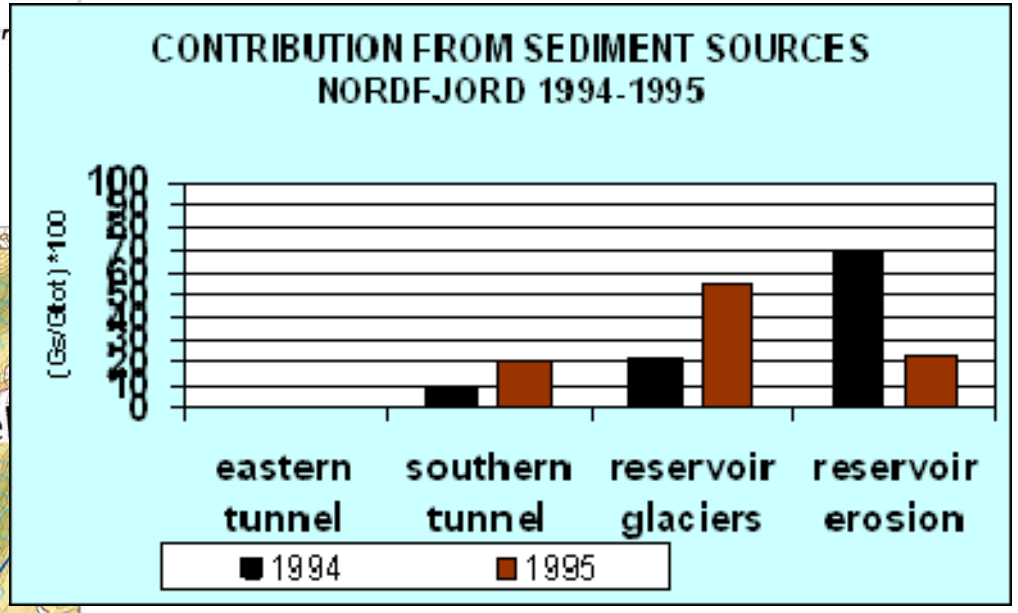


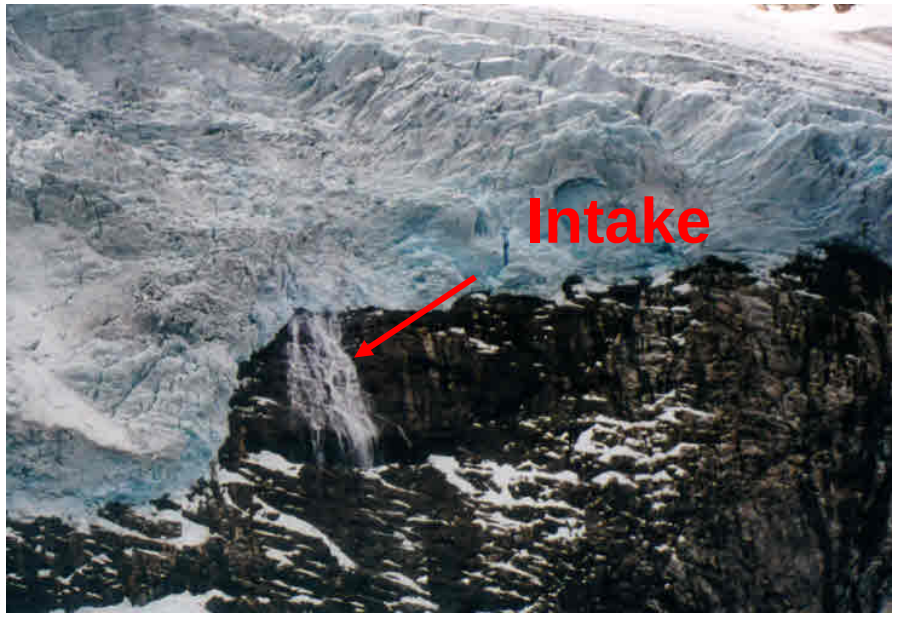


SVARTISEN POWER PLANT
Diversion tunnels and intakes

Reservoir volume: 3500 mill m3
Drawdown: 125 m
Hydraulic head: 585 m
45 Intakes

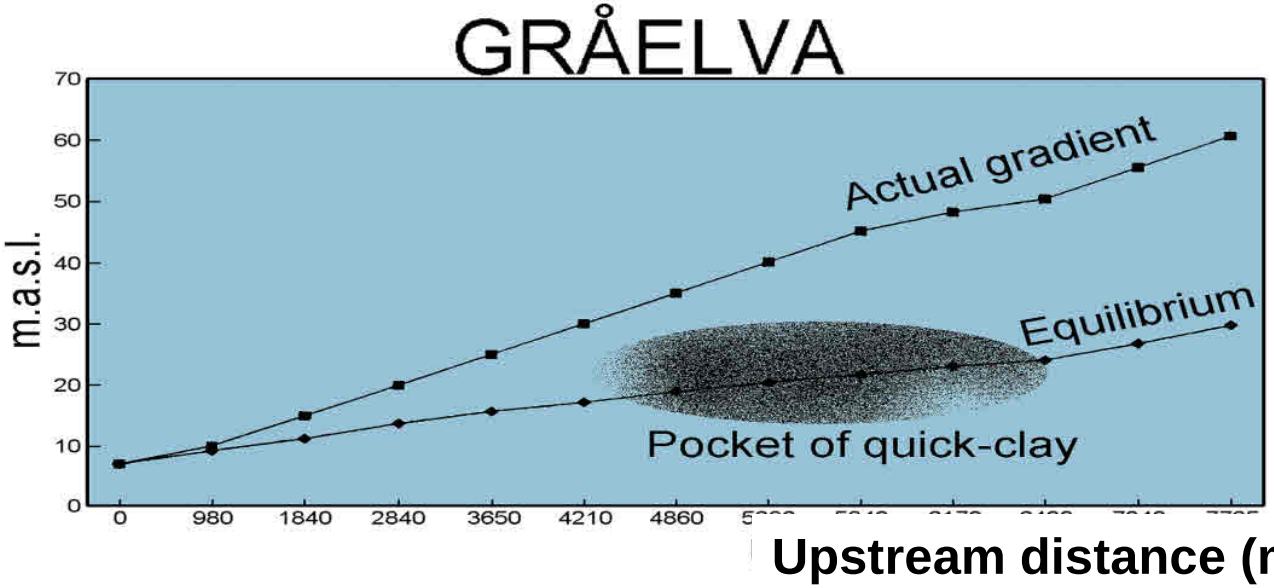
0 10 km
Scale

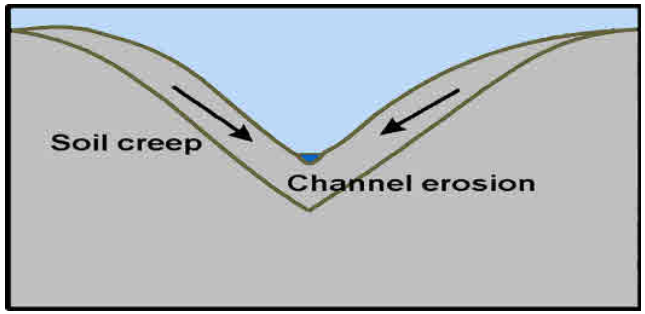


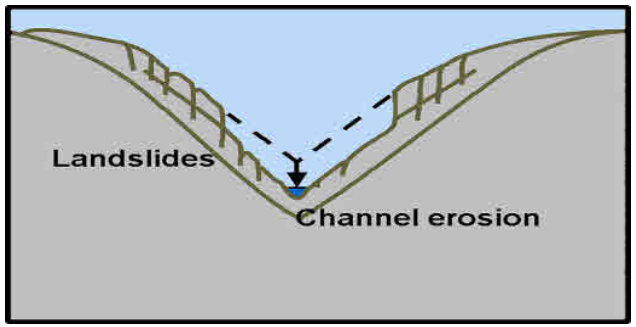


Fluvial erosion has triggered numerous large quick –clay slides

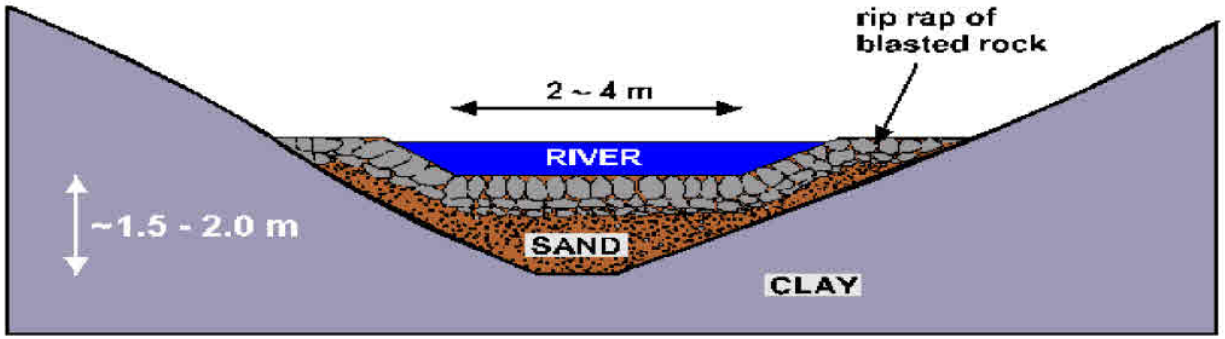
erosion protection works has been made to prevent major slides



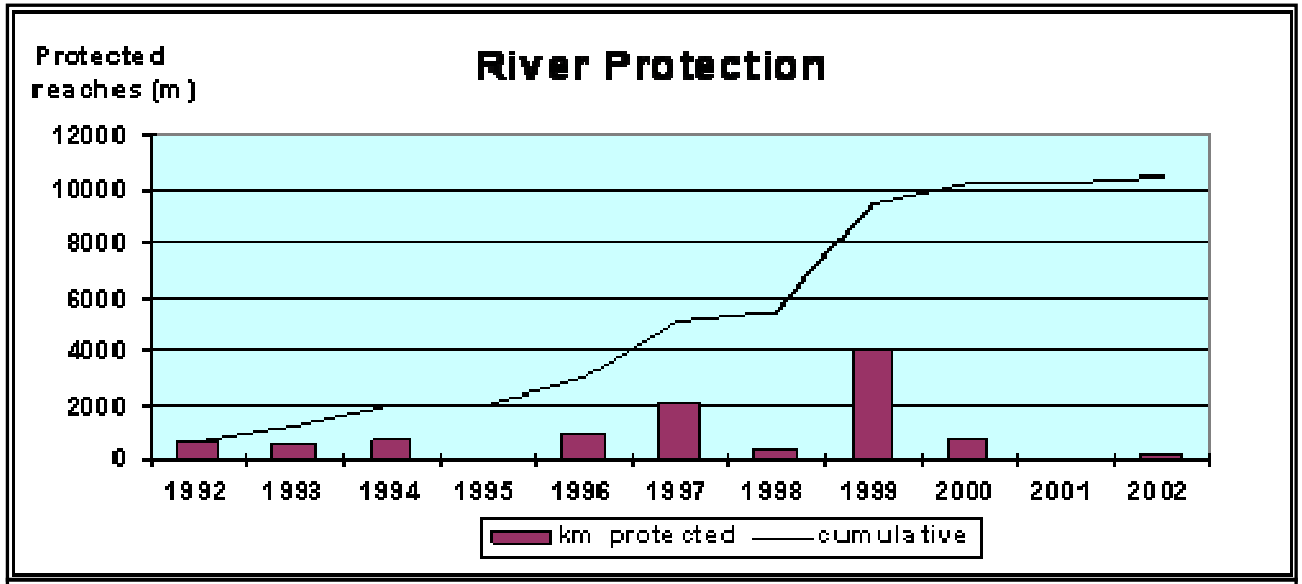


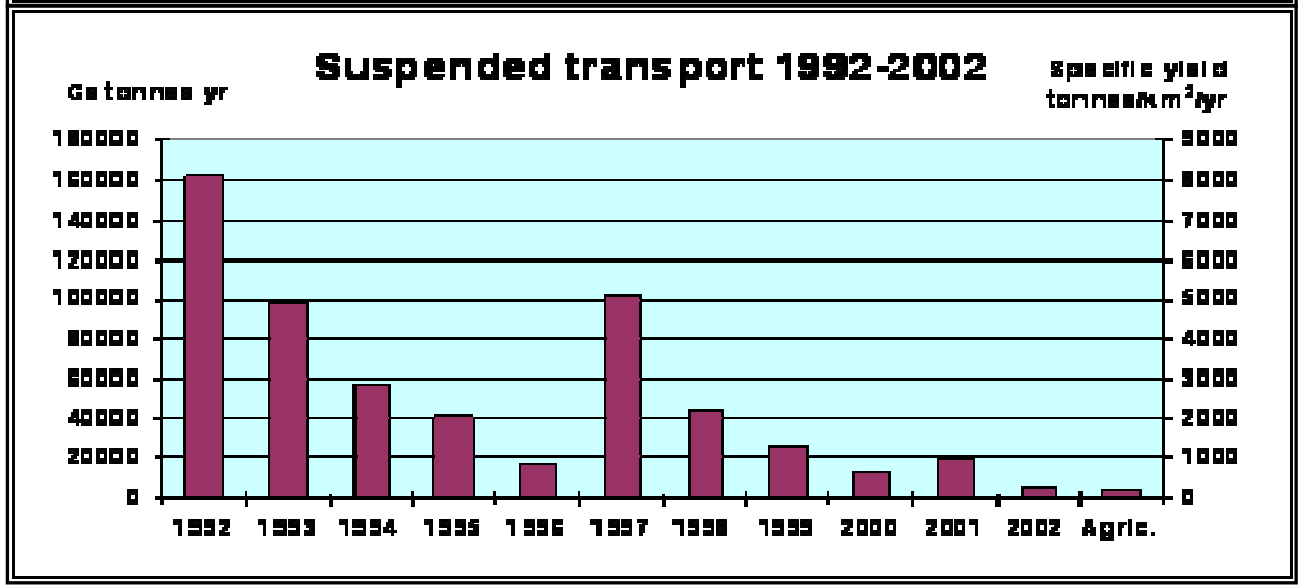


To prevent channel degradation the river bed was covered by an armouring layer

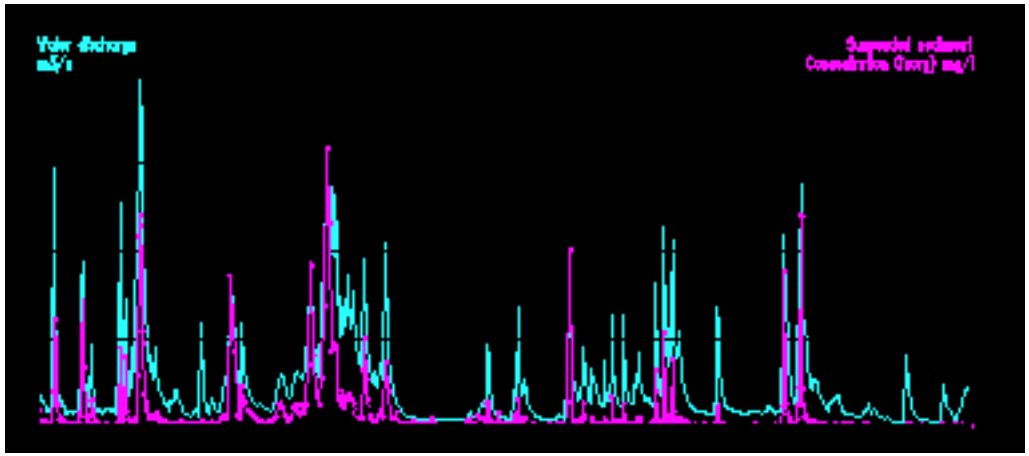


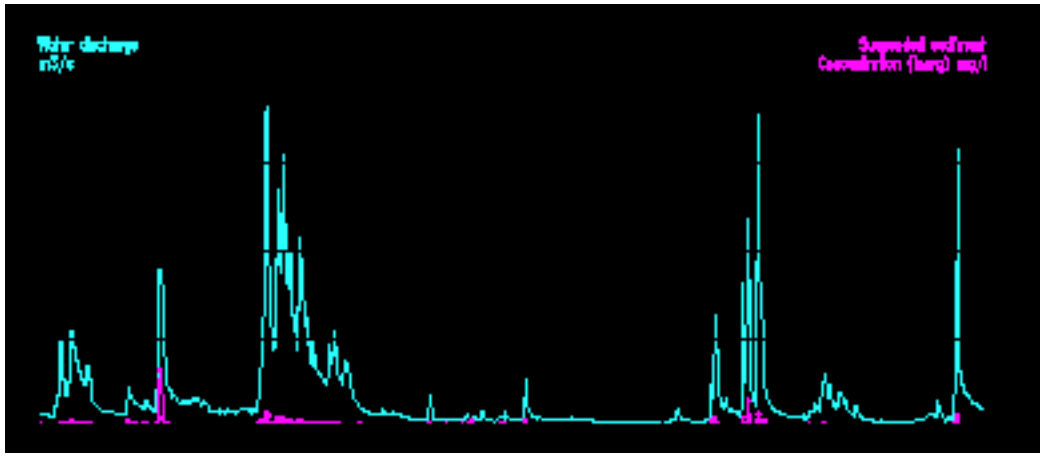
Erosion protection works did reduce the sediment load





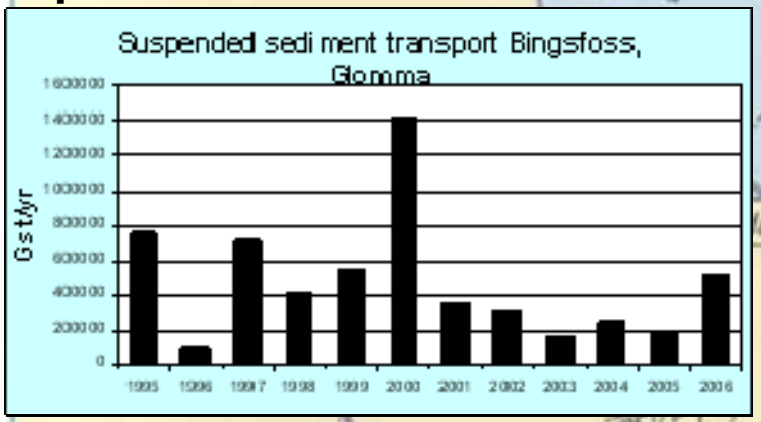
Suspended sediment concentration and water discharge





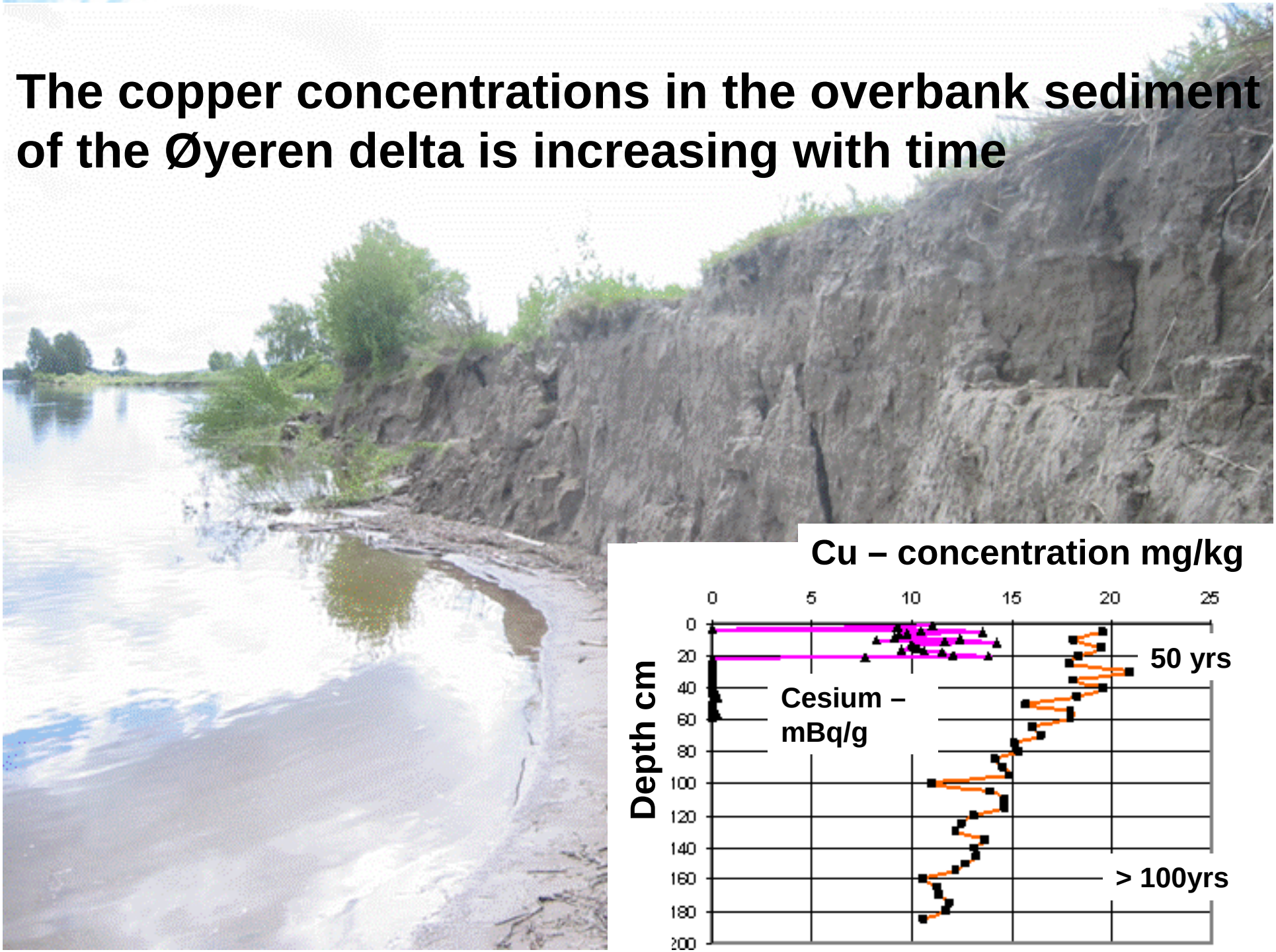
Dispersion of mine waste in the Glomma river basin - 40 000 km^2

Copper mines 300 yrs in upper part

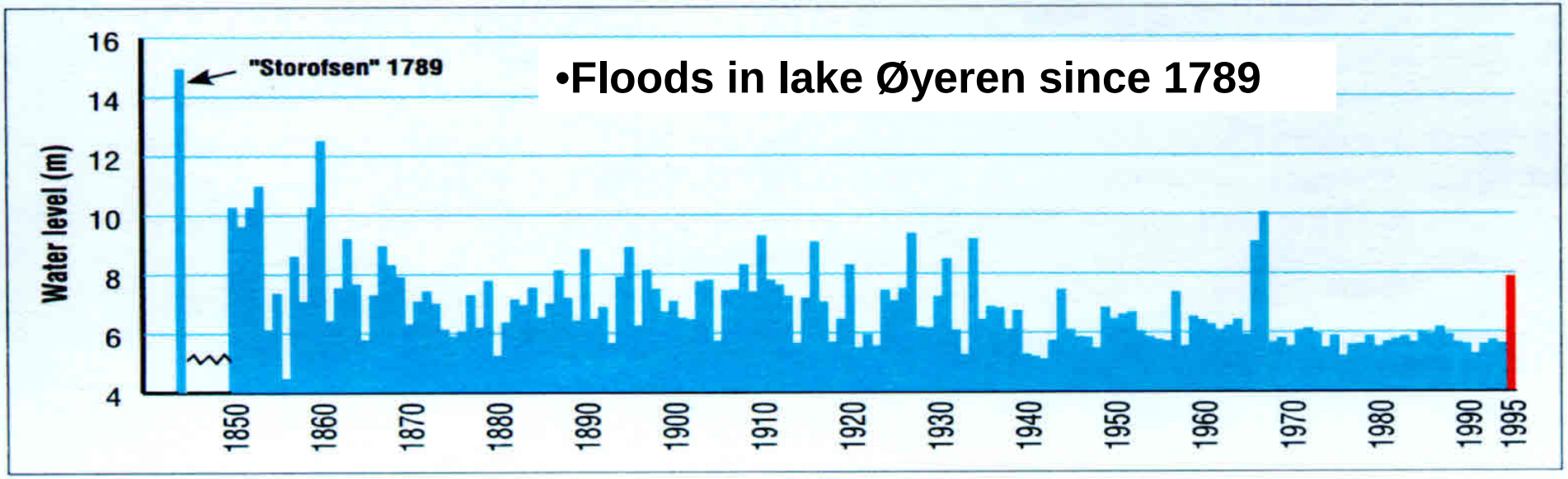


The Øyeren delta

The copper concentrations in the overbank sediment of the Øyeren delta is increasing with time




Large magnitude floods
convey Cu - sediments


"Storofsen" 1789
•Floods in lake Øyeren since 1789
Water level (m)
16
14
12
10
8
6
4
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
1995

Conclusions

- Largest natural background sediment yields in glacier- fed rivers and clay areas
- Hydropower development caused significant increase in sediment load
- Sediment load was decreased due to erosion protection works
- Copper concentration of floodplan sediments increase due to long term dispersion of mine waste