

## Recent organic matter accumulation in ombrotrophic peat bogs exposed to heavy metal load

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### Introduction:

Although metal contents of age-dated peat cores from ombrotrophic peat bogs have successfully been used to establish records of atmospheric heavy metal deposition in the past, the impact of metal pollution itself on the organic matter (OM) accumulation in peatlands has barely been studied. Our aim was to compare recent (last 125 years) net OM accumulation rates of heavy metal polluted ombrotrophic peat bogs with those of a background bog.

### Methods:

- Study sites (fig.1): Harjavalta (vicinity of a Cu-Ni smelter), Outokumpu (near a closed Cu-Ni mine), Alkkia (Ni treated site, 200 kg Ni/ha in 1962) and Hietajärvi (a background site).
- At each sampling site one peat core (15x15x100cm) was taken with Wardenaar corer (fig. 2).
- Each core was wrapped in a plastic foil and transported to the lab, frozen and cut into 1 cm slices with stainless steel saw band.
- Samples were dried (105 °C), milled in a centrifugal mill. Concentrations of As, Cu, Ni, Pb and Zn were measured using XRF, C with LECO-CS.
- Age-dating of peat was determined using <sup>210</sup>Pb method (CRS model).

### Results and discussion:

Based on <sup>210</sup>Pb age-dating, the upper 16cm peat layer at Harjavalta, 35cm at Outokumpu and 25cm at Hietajärvi and <1 cm at Alkkia represents 125 years of peat formation, yielding the following average OM accumulation rates at Harjavalta 1.3 mm a<sup>-1</sup>, 2.8 mm a<sup>-1</sup> at Outokumpu and 2.0 mm a<sup>-1</sup> at Hietajärvi (table 1). At the Alkkia site, the Ni treatment in 1962 had completely stopped the peat accumulation. The lower OM accumulation rate at Harjavalta compared to the other study sites gives some support to the hypothesis of retarded NPP due to the moss growth interference by metal toxicity (fig.3, table 2). Hence smelter derived pollutants might have caused reduced peat growth. In contrast at the Outokumpu site, even though it is in the vicinity of an old Cu-Ni mine, such an effect could not be observed. On the contrary, OM accumulation rates were the greatest at the Outokumpu site, even exceeding those at the background site Hietajärvi.

### Conclusions:

- At the Alkkia site Ni treatment in 1962 had completely stopped the peat accumulation.
- At the Harjavalta site, net OM accumulation rate was considerable less than at the Outokumpu and Hietajärvi sites → the emissions released from the nearby Cu-Ni smelter might have reduced the net OM and peat accumulation rates.
- There were no remarkable difference in peat accumulation rates between Outokumpu and the background site Hietajärvi.

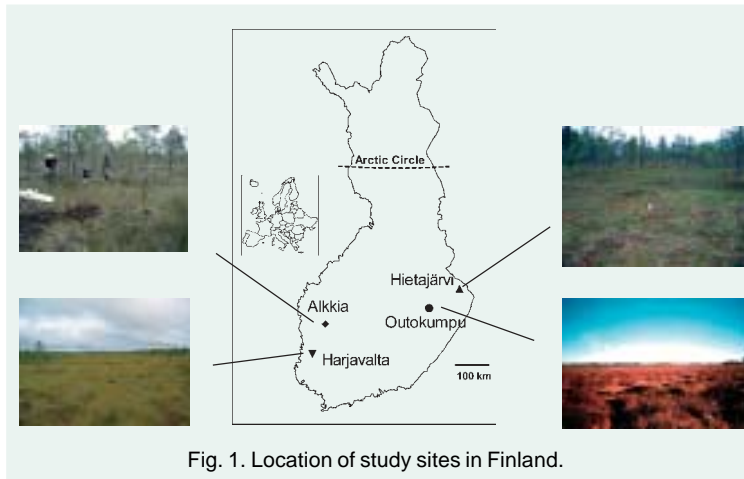


Fig. 1. Location of study sites in Finland.

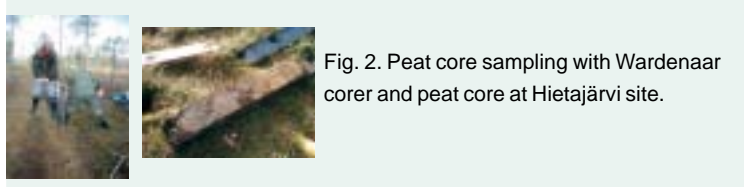


Fig. 2. Peat core sampling with Wardenaar corer and peat core at Hietajärvi site.

Table 1. Annual temperature and precipitation sums, thickness of peat, average peat increment, organic matter and carbon accumulation at the four study sites during the past 125 years.

Site	Annual temperature sum, °C <sup>a</sup>	Annual precipitation sum, mm <sup>a</sup>	Thickness of peat, cm	Increment mm a <sup>-1</sup>	Accumulated organic matter g m <sup>-2</sup> a <sup>-1</sup>	Accumulated Carbon g C m <sup>-2</sup> a <sup>-1</sup>
Harjavalta	1268	571	15.5	1.3	96	48.8
Outokumpu	1188	615	34.5	2.8	140	68.0
Hietajärvi	1064	616	23.5	2.0	115	54.6
Alkkia	1110	612	< 1	—	—	—

<sup>a</sup>for period 1950 - 1999 estimated using the method described in Ojansuu, R. & Henttonen, H., Silva Fenn. 17(2):143-160 (1983).

Table 2. As, Cu, Ni, Pb and Zn average concentrations (mg kg<sup>-1</sup>) in the 125-year-old peat layer (min and max in parenthesis).

	As	Cu	Ni	Pb	Zn
Harjavalta	5.9 (3.4-8.5)	280 (18-1268)	152 (31-278)	40 (21.4-59.8)	136 (76.8-187.5)
Outokumpu	2.6 (0-4.4)	21 (5.5-68.8)	6 (0-20.8)	13 (3.2-24.3)	62 (38.8-89.3)
Hietajärvi	4.1 (0-6.3)	3 (0-5.6)	2 (0-6.1)	17 (2.3-27.0)	60 (27-110.8)
Alkkia	3.8 (1.9-7.5)	17 (13.5-21.9)	717 (268-1043)	56 (31.5-70.9)	104 (67.9-128.4)

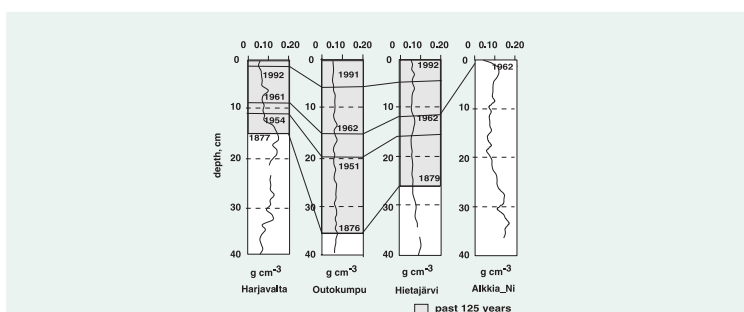


Fig. 3. Bulk density of peat from surface layer to the depth of 40 cm at Harjavalta, Outokumpu, Hietajärvi and Alkkia sites. Connecting line between cores indicates peat of same age.

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