HEAVY METAL DEPOSITION ON PLANTS IN RELATION TO IMMISSION AND BULK PRECIPITATION.

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Monitoring of heavy metal accumulation in plants has been used to reflect the deposition of heavy metals in terrestrial ecosystems. In some cases the accumulation rates in plants are lineary correlated to deposition measured as bulk precipitation collected in funnel samplers. It is uncertain, however, how large the contribution due to adsorption/impaction of small particles is to this relationship. The need for design of enligthening experiments on deposition rates in different vegetation types and their relation to immission and bulk precipitation data is discussed.

A number of studies have presented a linear relation between bulk precipitation and heavy metal uptake. (e.g. ANDERSEN et al. 1978, PILEGARD 1978) This result was observed in in situ as well as transplanted lichens and bryophytes. Close to point sources, however, this relation was no longer top soil levels and bulk precipitation was not linear, but exponential. These two latter observations point to the fact, that the deposition on plant surfaces is strongly dependent on particle size distribution.

Close to the source, the larger particles are more predominant, and the rapid settling velocity hereof result in a relatively large trace metal uptake here due to large particles. On the other hand, large particles are washed off or blown off surfaces more easily than small particles, which would result in the observed stronger increase in top soil levels with proximity to the source area in comparison with above ground plant parts.

absorption minimum in the vicinity of 1 μ as particle diameter has been found. Obviously, differences in particle composition as a function of size makes it even more difficult to extrapolate from trace metal levels in plants to immission and total deposition — the latter not being identical with bulk precipitation.

In Glostrup, an industrial region 10 km west of Copenhagen, a rather strong trace metal pollution in the air has been observed. Lichens, bryophytes and Achillea millefolium was, together with tot soil analysis, used to reflect the trace metal deposition in the area. The Pb-levels in lichens were extremely high, valid, and furthermore, the relation between and the thallus of Lecanora conizaeoides was analyses by scanning electron microscopy in combination with an X-ray emission spectrograph (SEMEX-technique). In one of the investigated lichen slices measuring 140x 140x 10 µ³ one particle measuring about 1 μ in diameter was observed. (Fig. 1) The patricle gave a strong Pb-L α -signal indicating a very high lead content of the particle. Only 8 particles of this size and a composition e.g. corresponding to that of Pb0 would result in a total Pb-level of 1000 ppm dry matter in the lichen thallus. As above ground plant parts is capable of filtrating the air for its content of small particles, the contribution to the total trace In the lower particle size range, an metal load herefrom may often be underestimated. In the above investigation area, the region with Pb levels higher than background had a larger distribution than the area with elevated Pb bulk precipitation levels. This corresponds to the fact, that Pb in imission measurements mainly was attached to particles in the low size range $(0-1\mu)$. Closer

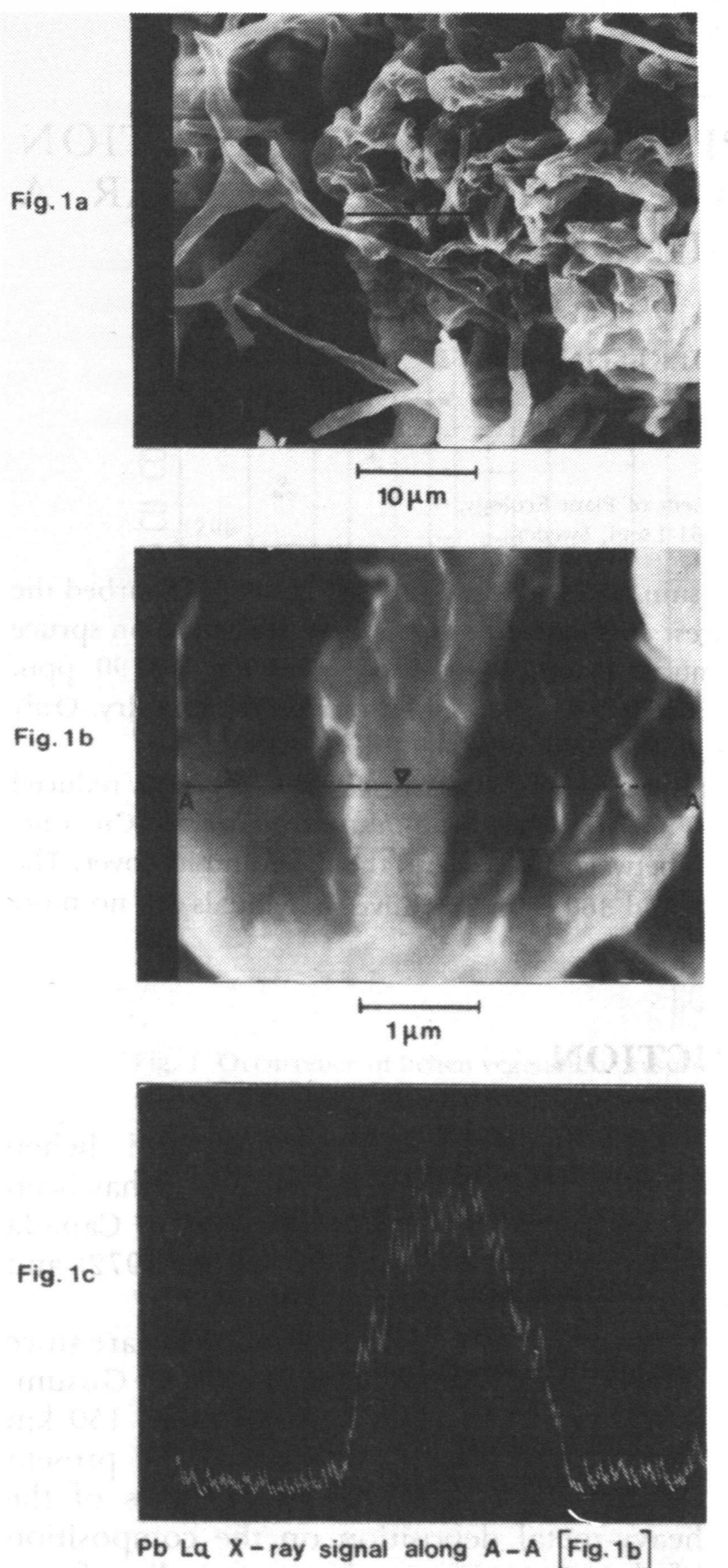


Fig. 1. S.E.M. - photographs of cross sections from the medulla of Lecanora conizaeoides Nyl. ex Cromb collected at Glostrup, Copenhagen. The arrow points at a lead containing particle.

to the source area a higher Pb percentage was found in larger particles (FLYGER et al. 1976). Particles containing Si, Ca, Ti and Fe was covering a wide size range in the whole region. The conclusion is, that the relation between total deposition and heavy metal uptake in monitor plants is a function of the actual particle size spectrum. Thus, where this relationship is unknown, the total deposition determinations must involve analysis of trace metal input to above ground plant parts as well as to their substratum - the top soil during the same period of time. Till now, such determinations have not been made, and must be encouraged in order to assess the total input to terrestrial ecosystems of trace metals from the atmosphere.

A second important difficulty in the application of monitor plants in characterizing the trace metal immission is to determine the time needed to reach a steady state equilibrium with respect to the monitor plant metal level following a given change in the trace metal immission. Transplantation experiments with lichens and mosses have shown, that at least 7 months is required to attain this equilibrium in a strongly polluted area. This was shown by the difference, especially close to the source, between the in

situ and transplant trace metal levels after 7

months exposition (PILEGARD 1978).

The problem of determination of the equilibrium time lag, which is far from solved, is important when we wish to translate changes in monitorplant levels to trends for crops and pastures. Furthermore, it emphasizes the need for long term monitoring based on dynamic descriptions of ecosystems with similar structure as economic important systems within forestry and agriculture. This approach has till now not been applied in Denmark.

LITERATURE

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