St. Lawrence Valley trace metal deposition history from peat bog records

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Ombrotrophic peatlands provide reliable historical records of atmospheric metal deposition, in particular for lead [1]. In comparison to Pb, the behaviour of other trace metals in peat bogs in not as well understood. To date, most studies were carried out in Europe and served to document various periods of anthropogenic activities. In contrast, records of atmospheric metal deposition in North America are still scarce. The present study focuses on the reconstruction of the recent history of trace metal deposition (Pb, As, Cd, Ni and Zn) along the St. Lawrence Valley (SLV).

Cores (50 to 100-cm long) were collected in four ombrotrophic peat bogs along the SLV. Cores were sub-sampled at 1 to 5-cm intervals and analysed to reconstruct the recent history of atmospheric metal deposition (Pb, As, Cd, Ni and Zn) in the region. Core chronologies were established using ^{210}Pb for the surface horizons and 14C dating for the deeper sections. Regional, natural background metal concentrations were established from the analysis of samples from the bottom of the bogs. When only core samples were available, values for the upper continental crust (UCC) were used [2]. Measured background metal concentrations were then used to compute enrichment factors and distinguish between anthropogenic and natural sources (i.e. crust) [3]. Sc was used as a reference element, as its mineral phases are resistant to alteration.

Preliminary results show that anthropogenic concentrations for Pb, As, Cd increased sharply from the beginning of the 19th through the 20th century, to reach a maximum between 1940 and 1970. The age and amplitude of these peaks vary spatially along the SLV and between elements and, in some cases, can be associated with specific anthropogenic activities (e.g. smelting) or the convergence of different air masses. Since the 60's, lead concentrations have decreased rapidly, following the ban on leaded gasoline, but they have not reached pre-anthropogenic levels. Vertical profiles of Cd and As are similar to Pb, whereas Zn displays a strong enrichment in the first centimetres of the bogs, possibly reflecting a bioaccumulation by the living vegetation. Whereas this surface enrichment renders historical reconstructions of Zn deposition more difficult, enrichment factors throughout the cores are high enough to confirm the impact of anthropogenic Zn. Results show that the South-Western SLV has been more impacted by anthropogenic metal deposition.

References

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