



Peat bogs and their organic soils: Archives of atmospheric change and global environmental significance (Philippe Duchaufour Medal Lecture)

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A bog is much more than a waterlogged ecosystem where organic matter accumulates as peat. Peatlands such as bogs represent a critical link between the atmosphere, hydrosphere, and biosphere.

Plants growing at the surface of ombrotrophic bogs receive nutrients exclusively from the atmosphere. Despite the variations in redox status caused by seasonal fluctuations in depth to water table, the low pH of the waters, and abundance of dissolved organic matter, bogs preserve a remarkably reproducible history of atmospheric pollution, climate change, landscape evolution and human history. For example, peat cores from bogs in Europe and North America have provided detailed reconstructions of the changing rates and sources of Ag, Cd, Hg, Pb, Sb, and Tl, providing new insights into the geochemical cycles of these elements, including the massive perturbations induced by human activities beginning many thousands of years ago. Despite the low pH, and perhaps because of the abundance of dissolved organic matter, bogs preserve many silicate and aluminosilicate minerals which renders them valuable archives of atmospheric dust deposition and the climate changes which drive them.

In the deeper, basal peat layers of the bog, in the minerotrophic zone where pore waters are affected by mineral-water interactions in the underlying and surrounding soils and sediments, peat serves as an important link to the hydrosphere, efficiently removing from the imbibed groundwaters such trace elements as As, Cu, Mo, Ni, Se, V, and U. These removal processes, while incompletely understood, are so effective that measuring the dissolved fraction of trace elements in the pore waters becomes a considerable challenge even for the most sophisticated analytical laboratories. While the trace elements listed above are removed from groundwaters (along with P and S), elements such as Fe and Mn are added to the waters because of reductive dissolution, an important first step in the formation of lacustrine Fe and Mn nodules.

While these important chemical reactions have taken place silently and imperceptibly over millenia across the Earth wherever climate and water allow bogs to form, at the same time, peat bogs represent an important component of the biosphere and provide a home to many unique plants and animals, thereby contributing to the vast biodiversity found on Earth.