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Record of anthropogenic impact in remote Arctic peatlands

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Trace elements, Pb isotopes, spheroidal aluminosilicates (SAPs)—high temperature coal combustion markers—and plutonium ($^{239+240}$Pu) were analyzed in three ^{210}Pb-dated Arctic peatlands located in Iceland, Spitsbergen and Alaska. Although the maximum Pb concentrations at the studied sites are similar (4–10 mg kg^{-1}), the timing of peak deposition differs considerably.

In Spitsbergen, the highest Pb levels occur around 1960, coinciding with a marked decrease in the ^{206}Pb/^{207}Pb ratio (from 1.2564 to 1.1487) and the first detection of SAPs. In Iceland, anthropogenic Pb input also becomes evident around 1960, as indicated by a decrease in the ^{206}Pb/^{207}Pb ratio (from 1.20 to 1.11), followed by the initial occurrence of SAPs in approximately 1980. In contrast, in Alaska the maximum Pb peak appears around 2000; however, it is not accompanied by a substantial decline in the Pb isotopic ratio with depth, and SAPs are absent from the sediment. Here, the ^{206}Pb/^{207}Pb ratio varies only slightly, within the range 1.199–1.227. A distinct peak in $^{239+240}$Pu corresponding to the global nuclear weapons testing fallout of 1952 and 1963 is clearly visible in all profiles (Fiałkiewicz-Kozieł et al., 2025).

Although each peatland records a different trajectory of industrial Pb contamination as well SAPs deposition —driven by long-range atmospheric transport in Iceland and Spitsbergen, and more regional sources in Alaska—all sites show a pronounced rise in Pb concentrations alongside a clear nuclear weapons testing signal. These findings highlight the value of Arctic peatlands as sensitive archives of globally distributed, human-driven environmental change.

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Fiałkiewicz-Kozieł, B., Smieja-Król, B., Łokas E., Cwanek, A., Plado, J., Mróz, T., Wąsowicz, P., Gałka, M. (2025). Synchronizing Pu fallout and Inorganic Fly Ash Particles record in Northern Hemisphere peatlands. Science of the Total Environment 993: 180011. DOI: 10.1016/j.scitotenv.2025.180011