

Technogenic particles as a tool for the identification of large-scale industrial pollution in environmental archives

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Technogenic particles are formed during industrial processes. When resistant after deposition, they can be used as markers of industrial activity, giving spatially and temporally resolved signals in sediments. Here we focus on the determination of ash particles emitted during large-scale coal combustion in three regions differing in industry development and landscape morphology.

50 cm-long peat profiles were collected at the Sudety Mountains (SM; Czech-Poland border), Silesia Upland (SU; Poland), and West Siberian Plain near Tomsk (WSP-T; Russia) and cut into 1 cm thick slices. For X-Ray Diffraction analyses (XRD, PANalytical X'Pert PRO PW3040/60), peat samples were ashed at 500 °C and treated with 1 M HCl for 15 min. The chronology was assessed using ²¹⁰Pb and ¹⁴C.

Mullite (Al₆Si₂O₁₃) was the only crystalline phase of technogenic origin detected in ashed peat samples using XRD. The phase is emitted to the atmosphere in large quantities during high-temperature (>1100°C) coal combustion as an effect of the transformation of coal-hosting kaolinite and feldspars [1]. The pattern of mullite distribution differs between profiles (Fig. 1). The first appearance of mullite in SU (the 1920s) and WSP-T (1980s) is indicative of the beginning of energy production in coal-based power plants in the regions and represents the local scale. In the mountainous SM, gathering pollution from Central and Western Europe, the beginning reveals a more regional industry intensification, spanning hundreds of kilometers. The maximum mullite deposition is between the 1960s-1980s in Europe and much later in Tomsk (>2000y), which is typical for Asia [2].

Mullite is proposed here as an indicator of industrialization in geological records. It is resistant to post-depositional processes, emitted globally, and restricted to large-scale industry. The localization of the archive determines if the recorded signal is of local or regional importance.

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References

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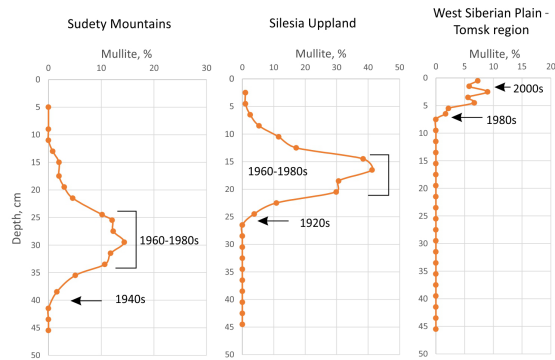


Fig. 1. Mullite distribution in peat profiles.