Anthropogenic impact and environmental pollution over Southeastern Europe during the last 8000 years

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The exploitation of mineral resources, an essential driver of economic and technological development, also induces long lasting impacts on the global ecosystem. Aerosols such as volatilized elements and chemical aggregates released during mining, smelting and combustion are deposited further away onto peats or lake sediments. The geochemical study of such proxies coupled with isotopic tracing of pollution sources provides an indirect, albeit fundamental view on past anthropogenic impact and environmental pollution.

Here we present newly acquired high-resolution geochemical (major and trace elements) and lead isotopic data (^{206}Pb, ^{207}Pb, ^{208}Pb, ^{204}Pb,) on several peat records from the Carpathians that cover most of the Holocene, with a special focus over periods with enhanced human impact on the environment, such as the Early Metal Ages, the Antiquity, Medieval and the recent past. We distinguish signatures related to the natural cycling of elements from the anthropogenic contributions due to natural resource exploitation, mining, and smelting activities. Together with existing geological, archaeological, and archaeometric evidences, our results provide a comprehensive record on the long-term history of metal-use development in the Carpathian region. Through a comparison with records from other parts of Europe we document the existence of strong regional differences in the magnitude, temporal, as well as spatial shifts in our understanding of past emission sources. We therefore show that the existing picture of past pollution load and temporal variability at the European scale is incomplete because it is mainly based on western records without considering the long-term pollution inputs from southeastern Europe, a region with significant mineral endowment and long-lasting human impact on the environment driven by the early rise of agricultural and metal processing activities.

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