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A comparison of lead behaviour in two geochemical archives in the vicinity of a lead smelter

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The content of lead (Pb) and selected base cations and 206Pb/207Pb isotope ratios in spruce (Picea abies) tree rings and peat cores from the Brdy Hills (Czech Republic) area were compared with those in spruce tree rings in the vicinity of the Pb smelter. Quadrupole ICP MS was employed to determine the elemental composition and 206Pb/207Pb isotope ratios. The individual peat core layers were dated using alpha spectrometric measurement of the 210Pb activity. Maximum Pb content in peat profiles (up to 550 mg/kg Pb) and tree rings (up to 60 mg/kg Pb) corresponds to a peak of metallurgical production in the mid 1970s and highest smelter emissions in the early 1970s. The Pb concentration patterns obtained from peat deposit profiles closely correlate with the Pb concentrations in spruce tree rings. The small differences between the individual tree cores, with the identical general trend, may be attributed to the difference in distance from the smelter and the altitude of each sampling site. Similar behaviour to Pb can be observed for Cd and Ca. The metallurgy of the Pb ores (206Pb/207Pb = 1.16), lithogenic Pb (206Pb/207Pb = 1.2), metallurgical processing of automobile batteries (206Pb/207Pb = 1.17) and the combustion of coal (206Pb/207Pb = 1.17-1.19) yield isotopic signatures that determine the isotope compositions of the individual peat profiles. Lead isotope composition in tree rings (206Pb/207Pb = 1.143 - 1.174) is controlled mainly by the smelter emissions

(206Pb/207Pb = 1.16 - 1.17), with the exception of the youngest segments from the more distant locality from the smelter, which yield isotopic signatures corresponding to car-emission Pb (206Pb/207Pb = 1.143 - 1.150). Higher content of Mn, Mg and Ca in tree rings corresponding to the 1970s and 1980s may be related to soil chemistry changes caused by acid deposition. In addition, an increase in K, Mg (and in some cases also Mn) in the youngest part of wood cores corresponds to the physiological processes in sapwood, and may be influenced by a decrease in Pb in organic soil horizons, which limited the cycling of basic inorganic nutrients.