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Lead mobility in smelter-affected soils

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Base metal smelters are important local sources of heavy metal pollution. The present study was focused on highly polluted soils and emissions in the vicinity of the Pb smelter at Pribram, Czech Republic. The kinetic batch leaching experiments showed that smelter fly ashes are highly reactive in water. Significant releases of Pb into the solution and changes in mineralogy with anglesite (PbSO4) as a final stable product were observed (Ettler et al., 2005, ES&T, 39, 9309). Up to 3.5 % Pb was determined in forest soil in the vicinity of the smelter. The sequential extraction analysis showed that the dominant Pb exchangeable fraction in forest soils is thought to correspond to weak electrostatic binding on the functional groups of organic matter. In tilled soil, Pb is predominantly bound to Fe and Mn oxides. The calculated mobility factors showed that up to 72% of Pb is mobile and bioavailable in forest soils. In contrast, the bioavailability of Pb in tilled soils was significantly lower as the mobility factors accounted for up to 30%. In the most polluted horizon of forest soil profile, the X-ray powder diffraction (XRPD) analysis confirmed the presence of anglesite (PbSO4), derived from the smelter emissions (Ettler et al., 2005, Chemosphere 58, 1449). The Pb isotopic composition (206Pb/207Pb) in smelter-impacted soils was compared with that of bedrocks and waste materials from Pb metallurgy (smelting slags, fly ashes). A coupled concentration/isotopic study of soil profiles showed that the smelter-induced pollution had penetrated even to the mineral soil horizons, indicating an important vertical mobility of Pb contaminant within the soil profile. The calculated downward penetration rate of Pb in soils ranged from 0.3 to 0.36 cm y-1 (Ettler et al., 2004, Anal. Bioanal. Chem. 378, 311).