Mineral composition and magnetic properties of technogenic particles originated from non-ferrous metal smelting activities

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The subject of research were technogenic magnetic particles (TMP) collected from dust produced during the non-ferrous metallurgical processes and from soils surrounding smelters in Upper Silesia, Poland.

The aim of the study was to determine their magnetic susceptibility (χ) and mineral and chemical composition.

Samples were investigated by X-ray powder diffraction (XRD) and scanning electron microscopy (SEM) in addition to the bulk magnetic susceptibility measurements using MSB Bartington.

Values of bulk magnetic susceptibility range from 5 to 873 × $10^{-8}m^3kg^{-1}$ for dust, and from 35 to 429 × $10^{-8}m^3kg^{-1}$ for soils. Such a wide range of magnetic susceptibility is indicative of complex and variable mineral composition of TMP.

Dust samples are composed of 40–80 vol.% zincite ZnO; 2–30 vol.% lanarkite Pb (SO)O; 5–30 vol.% challocolloite KPb_2Cl_5; 6–24 vol.% anglesite $Pb(SO_4)$, 2–7 vol.% sphalerite ZnS; up to 8 vol.% metasideronatrite $Fe(SO_4)_2(OH)(H_2O)$ and franklinite $(Fe,Mn,Zn)(Fe,Mn)_2O_4$; up to 5 vol.% galena PbS and palmierite $K_2Pb(SO_4)$; and of less than 2 vol.% monteponite CdO and otavite $CdCO_3$. Lead and some Cd occur mostly in sulfates, carbonates and chlorides.

Soil samples are composed of spherical glassy aluminosilicates, quartz, feldspars, iron oxides (hematite, magnetite; franklinite, magnesioferrite, jacobsite), barite, and coronadite $Pb(Mn^{4+}\ Mn^{2+})_8O_{16}$. The latter has rarely been observed in the environmental samples. Iron in the investigated minerals is mostly trivalent; whereas Mn is divalent and occurs in spinels often accompanied by iron and/or lead oxides.

The research project received funding from the National Science Center of Poland on the basis of the decision number DEC-2013/09/B/ST10/02227.