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Characterization of Aerosol Particles around an Open Pit Coal Mine in Germany

Doerthe Mueller-Ebert, Martin Ebert, and Stephan Weinbruch

Environmental Mineralogy, Institute of Applied Geosciences, Technical University Darmstadt, Schnittspahnstr. 9, 64287 Darmstadt, Germany (doe@geo.tu-darmstadt.de)

PM_{10} around open pit coal mines in Germany frequently exceeds the 24 hours limit value of 50 $\mu g/m^3$. To comply with current EU regulations appropriate mitigation strategies have to be developed. For this goal accurate source apportionment is an indispensable prerequisite. In this study characterization of the dust immission was performed by electronmicroscopic individual particle analysis.

Particles were collected close to the open pit mine from January 2007 until February 2008 with a two stage cascade impactor (aerodynamic particle diameter: 0.4 – 1 μm and 1 – 10 μm). The size, shape, and chemical composition of more than 30,000 particles were determined by automated scanning electron microscopy (SEM) and energy-dispersive X-ray microanalysis (EDX).

The most abundant particle groups encountered are secondary aerosol particles, soot, silicates, silicate/coal mixtures, coal, sulfates, carbonates, Fe-rich particles and (aged) sea salt.

The relative abundance of the different particle groups is highly variable as function of the specific meteorological conditions. It can be distinguished between at least three different scenarios, which were found to cause exceeding of the daily PM10 limit value.

a) high concentrations of silicates and silicate/coal mixtures which can be assigned to mining activities,

b) high concentrations of secondary aerosol particles and soot (urban background), occurring during inversion periods with stagnant air masses, and

c) high concentrations of (aged) sea salt indicating direct transport of air masses from the North Sea.

$PM_{2.5}$ and PM_1 are always dominated by urban background aerosol (secondary aerosol particles and soot). Following these results, significant reduction potentials for PM_{10} only exist for the contribution of the open pit mine (silicates, silicate/coal mixed particles) and for urban background aerosols (secondary aerosol particles and soot).

As the contribution of the open pit mine is mainly apparent in the $PM_{10-2.5}$ fraction, but adverse health effects are more likely associated to the PM_1 fraction (respectively particle number concentrations or surface area) a possible conflict of goals in the reduction strategies may arise depending if the focus is set at permissible value of PM_{10} or the relevance for adverse health effects.