Mineralogy of tropospheric dust in industrial regions – A case study of Upper Silesia, Poland

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The tropospheric dust loading in industrial regions shows a steady supply of minerals and other particulate matter from natural and anthropogenic sources (industrial emitters, domestic heating, transportation, etc). While the amount of particulate matter is continuously monitored in numerous locations worldwide for sanitary purposes, its minerolgy is inspected only occasionally. We have been studying mineral compositions and grain size distribution of airborne and deposited dust particles for over a decade in several locations within and around the Upper Silesia – one of the largest industrial centers in Europe producing 38.5 Mg of atmospheric dust annually.

The most common dust dust consist of quartz, various crystalline and amorphous aluminosilicates, Fe oxides, gypsum, bassanite and other sulphates, soot, coke, and graphite. The inventory of minor phases encompasses a long list of minerals including such unexpected phases like gold. Some of them, e.g. barite and REE-phosphates are related to coal burning and occur so frequently that they can be used as mineral indicators of specific source of dust emission. They were detected even in the least polluted parts of the country as a result of local low emission.

Minerals related to human activities are primary, i. e. detrital grains ejected from the emitters within dust and gas plumes or secondary, i. e. condensates or products of chemical reactions between dust particles and airborne acids (mainly sulfuric acid). Grain morphology and some other features may help to distinguish between primary and secondary dust particles.

Minerals related to low-emission sources, particularly gypsum and barite, are abundant in winter (heating season), whereas natural dusts and dust from high-emission (industrial) sources occur in almost constant abundances throughout the year being predominant in summer.

The size range of of suspended dust particles depends on the height of sampling with the most of respirable dust (<5 μm) occurring at higher elevations, e.g. 100 m a. g. l..

Environmental impact and health hazard to general population associated with heavy metal-bearing soluble minerals often embedded in hydrocarbon materials respirable aerosols have been evaluated.

Microbial fuel cell study of the role of OmcA and MtrC in electron transfer from *Shewanella oneidensis* to oxide electrodes

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Although microbial fuel cell (MFC) experiments have been conducted previously with the metal-reducing bacterial species *Shewanella oneidensis* MR-1 (So) and various mutants, such experiments have not been conducted using an oxide anode akin to minerals found in natural systems. Here, we use So and the deletion mutants *ΔomcA*, *ΔmtrC*, and *Δ (omcA/mtrC)*. We used F-doped SnO_2 (FTO) anodes with excellent conductivity. New experiments are currently underway with nanocrystalline hematite films. Experiments were conducted in triplicate for 25 hours. The anode was held at 0.5V relative to Ag/AgCl (this results in a thin Schottky barrier that may limit current density). Experiments were conducted in 5% H_2, balance N_2; anode and cathode chambers were separated by a proton exchange membrane. After an initial baseline period, cells were added to the anode chamber. 20 mM lactate was then added to the anode chamber and 20 mM fumarate was added to the cathode chamber. Lactate and fumarate were added every 6 hours thereafter, dividing the experiment into 4 phases.

The background-subtracted results indicate that the wild-type MR-1 (WT) gave the highest current densities, and that the deletion mutants gave current densities only slightly higher than the controls. For example, in the 2nd 6-hour period, WT gave 0.84±0.29 μA cm^{-2} whereas the deletion mutants gave 0.13±0.10, 0.15±0.15, and 0.09±0.06 μA cm^{-2} for *Δ (omcA/mtrC)*, *ΔomcA*, and *ΔmtrC* respectively. Strains missing MtrC always gave lower current density than those missing OmcA. By the last 6-hour period, however, the WT had decreased to 0.64±0.27 and *ΔomcA* had increased to 0.32±0.19 μA cm^{-2}. Cell counts were conducted after each experiment, and final current density per cell was similar for WT and *ΔomcA*, but more than a factor of two smaller for the other mutants. Growth occurs in all experiments; OmcA appears to be less crucial to electron transfer than MtrC; mutants appear able to use a secondary electron transport system when deprived of OmcA, or MtrC, or both.