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Assessing mercury distribution and speciation in the colloidal fraction of contaminated soils

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Mercury (Hg) is one of the most toxic elements that can be found in the environment either in organic and inorganic forms. Beside understanding the chemical speciation of Hg, also determining the size of the Hg-bearing particles is of paramount relevance to better assess the environmental fate and toxicity of this dangerous pollutant. In fact, soil colloidal particles (either organic or inorganic soil constituents) can be potentially mobilised, thus diffusing into other environmental compartments or endangering the health of living organisms and human beings.

In this study, we have been investigating the distribution and speciation of mercury in soil samples collected in an industrial area located in the South of Italy and polluted by chlorine-alkali Hg emissions. Soil samples were collected at two depths (0-10 and 40-50 cm) in different points located either inside the industrial area and within few tenths of meters all around the industrial site. The total amount of mercury in the soil samples sieved at 2 mm ranged from 1 to 250 μg/g. However, most of this Hg was found concentrated in the clay fraction (<2 μm). In this fraction, the amount of Hg was from 2 to 10 times higher than in the overall soil samples. In addition, SEM-EDX analyses evidenced the presence of sub-microscopic HgS phases.

Within this context, detailed Hg distribution in the soil colloidal fraction is being studied by Sd-FFF-ETAAS (Sedimentation Flow Field Fractionation coupled to Electro-Thermal Atomic Absorption Spectroscopy) to identify the most relevant Hg-bearing

fractions. In particular, SdFFF is an established method for the high resolution, mass based separation and sizing of small particles in the 0.05 – 1 μm size range.

By coupling on-line or off-line an atomic absorption spectrometer, the full elemental characterization of the suspended particles is also possible. From the first results it seems that most of the mercury is concentrated in two main fractions with a size in the order of few hundreds of nanometers.

The mineralogical composition of the clay fraction was also determined in order to find relations between Hg and reactive clay-sized soil minerals.

From these results, it emerges that particular attention should be paid to the submicrometer-sized soil particles that can potentially turn into a serious danger for other environmental compartments as well as for humans (e.g., by inhalation). All the obtained information can be used to formulate a wiser risk assessment and to develop more responsible remediation strategies.