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Ultra fined-grained atmospheric particulate studied by magnetic analysis

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We present the result of an investigation on the presence of ultrafine atmospheric particulate in the urban area of Turin by magnetic methods. Magnetic minerals are a common component of atmospheric particulate, mostly arising from a number of anthropogenic activities. Atmospheric particulate is well known to represent a serious health problem in urban area and recently the attention focused especially on fine (< 2.5 μm) and ultrafine (< 0.1 m) particulates which are proven to be particularly dangerous because if inhaled they penetrate deep and reach lungs alveoli. In the last few years number studies took advantage of magnetic techniques to successfully identify atmospheric particulate matter through the magnetic analysis, however they did not draw much attention to the grain size problem. Indeed magnetic techniques have the ability to distinguish very fine-grained material by using the thermal relaxation effect and thus they potentially constitute a useful analysis tool to recognize ultrafine fractions of atmospheric particulate.

We have performed low and room temperature isothermal remanent magnetization (IRM) and hysteresis loop measurements on atmospheric particulate samples in order to estimate the concentration of fine and ultrafine particles. Magnetic mineralogy was studied using IRM at room and liquid nitrogen temperature. Low temperature hysteresis and thermomagnetic curves were used study the grain size distribution that showed the presence of a mixture of low-coercivity particles, magnetite-like, and a variable grain-size populations. Samples were taken from filters collecting particulates matter with diameter < 10 μm (PM10) in different city areas, the particulate mass on the filter was also measured.

Results confirm the general correlation between magnetization and concentration of particulate in air. The comparison between suburban and high-traffic area also support the previous finding that anthropogenic particulate has a large concentration of magnetic minerals compared to natural sources. Moreover the low temperature measurements have shown the presence of a relevant amount of ultrafine particles which are superparamagnetic at room temperature, their concentration increase in areas of high traffic and also appear to be related to anthropogenic sources. The magnetization carried by of ultrafine particles is site dependent but always larger than room temperature magnetization suggesting that about 60-70% of the particulate matter in urban area is made of ultrafine particles of nanometric size (< 30 nm). At given environmental conditions (site) the ratio between superparamagnetic and stable single domain magnetizations was found to remain fairly constant over time, thus allowing effortless predictions.