Geophysical Research Abstracts,
Vol. 11, EGU2009-217-2, 2009
EGU General Assembly 2009
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Evaluation and application of biomagnetic monitoring of traffic-derived particulate pollution (Lancaster, UK).

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Inhalation of particulate pollutants below 10 μm in size (PM10) is associated with adverse health effects. Here we examine the utility of magnetic remanence measurements of roadside tree leaves as a quantitative proxy for vehicle-derived PM, by comparing leaf magnetic remanences with the magnetic properties, particulate mass and particulate concentration of co-located pumped air samples (around Lancaster, UK). Leaf samples were collected in early autumn 2007 from sites in close proximity to a major ring road (Figure 1 c), with a few additionally from background and suburban areas. Leaves were collected from lime trees (Tilia platyphyllos) only, to avoid possible species-dependent differences in PM collection. Magnetic susceptibility values were small and negative, reflecting the diamagnetic nature of the leaves. Low-temperature remanence curves show significant falls in remanence between 114 and 127 K in all of the leaf samples. XARM/SIRM ratios indicate that the dominant size of the leaf magnetic particles is between c. 0.1-2 μm. Analysis of leaf particles by SEM confirms that their dominant grain size is < 2 μm, with a significant number of iron-rich spherules below 1 μm in diameter. Particle loading is concentrated around ridges in the leaf surface; significant numbers of the finer particles (< 500 nm) are frequently agglomerated, most likely due to magnetic interactions between particles. Larger particles exhibit an irregular morphology, with high silica and aluminum content. Particle composition is consistent with exhaust outputs collected on a filter. Critically, leaf saturation remanence (SIRM) values exhibit strong correlation with the particulate mass and SIRM of co-located, pumped air samples, indicating they are an effective proxy for ambient particulate concentrations. Biomagnetic monitoring using tree leaves can thus potentially provide high spatial resolution data sets for assessment of particulate pollution loadings at pedestrian-relevant heights. Not only do leaf SIRM values increase with proximity to roads with higher traffic volumes, leaf SIRM values are c. 100 % higher at 0.3 m than at c. 1.5 – 2 m height.