Magnetic biomonitoring of traffic-related particle matter deposition: which data for which uses?

Sarah Letaïef *[1], Pierre Camps [1], Thierry Poidras [1], Delphine Bosch [1], Patrick Nicol [1]

[1] Géosciences Montpellier, CNRS.

Can we use environmental magnetism as a marker to the captation of traffic-related particle matter (PM) by mediterranean plants? To answer to that question, PM accumulations by hedges were studied in an experimental wind tunnel and in the case of the A9/A709 motorway junctions. Numerous geochemical studies have already demonstrated the possibility to trace sources and compositions of PM deposition on plants by using concentrations in trace elements (TE) and isotopic ratios. Otherwise, environmental magnetism is an alternative approach of biomonitoring, assuming that there is a direct connexion between the PM concentration of TE and the intensity of their magnetic properties, which allows to map the airborne pollutant depositions.
First experiments in a wind tunnel reveal that isothermal remanent magnetization relative change (IRM_{RC}) between before and after the pollutant injection is positive. Besides, IRM_{RC} values on leaves situated at the entrance of the tunnel are higher than those from the exit. These results are in line with the two airborne µ-sensors measurements, also located upstream and downstream to the hedge. The magnetic parameter has proven to be a good proxy to detect PM retention potential by the hedge.
Meanwile, results from along the motorway indicate that traffic-related PM are mainly composed of Cu, Zn, Sb, Pb which are directly derived from combustion residues, vehicles and equipment wears. A good correlation between IRM_{RC} and TE concentrations is noticed and validates our methodology. To confine the noise and the air pollution, three basic berms and a fourth located windward to the traffic being roofed with a noise barrier have been set up by the motorway company. Maximum IRM_{RC} are detected downstream of the noise barrier, which is located downwind while no significant deposition is observed on both sides of the basic berms. Because it seems counterintuitive and to complement magnetic analysis, a computational fluid dynamics modeling based on the Reynold-Averaged Navier-Stokes equations with the standard k-ε turbulence approach was performed and predicts as well, a recirculated pollution downstream to the berm wall combination, whereas the free-wall berm geometry does not alter air pollution transport and dispersion.

Mots-Clés : environmental magnetism, geochemistry, air quality, trace elements

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