Monitoring sediments pollution of the Garonne River using induced polarization and magnetic susceptibility measurements

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We characterized the impact of a big city (Toulouse, France) on the pollution of river sediments brought by urban discharges during rainfall. The samples collected at several locations in the river are characterized by IP and magnetic susceptibility measurements. The results show a clear influence of the city on the sediments. However, the curves of magnetic susceptibility and IP data along the river are anti-correlated, contrary to our a priori hypothesis. The nature of anthropogenic particles sluiced by rainfalls could explain this phenomenon. A complementary microscopic and mineralogical analysis of the samples will help us to understand the unexpected result of this study.

Introduction

Cities are the source of many polluting particles, often from human activities: industrial (heavy metals), traffic (hydrocarbons, heavy metals, various oxides), roads and urban construction (cement, paints, tar), and many other. During rain events, these particles are washed into the river, natural topographic receptacle. The spatio-temporal variability, randomness and diversity of origins make it difficult to characterize these emissions and their effect on aquatic environments (Truchot et al. 1994).

The purpose of this study is to characterize the impact of the Toulouse area on the pollution in the sediments of the Garonne. We used two geophysical parameters, chargeability and magnetic susceptibility, to monitor samples along the river.

Sampling and instrumentation

Sediments were sampled at seven sites from Portet-sur-Garonne (Toulouse upstream) to Grenade (downstream of the city) within the riverbed. Each time, we have kept the fraction 50-200 microns for the measures, which allows for more homogeneous samples from one site to another.

Fig. 1: Installation for IP measurements, the sample is in the centre, in the plastic tube.

For this study, we developed a device to measure the induced polarization in the laboratory with very small amounts of soil (about 10 mL). We used non polarisable electrodes (Fig. 1), both for receiving and injection. Measurements are made in temporal IP using a SAS1000 apparatus.

The magnetic susceptibility has been measured in the laboratory on the same samples with a Kappabridge KLY3 AGICO. To complete the interpretation of these data, we separate the heavy particles from some samples, and we observed them by electron microscopy.

Results and discussion

Figure 2 shows the measurement result of chargeability and magnetic susceptibility, ranging from upstream (left side of the figure) to downstream of the city (right side of the figure). Only the first sample (named P2*) is located upstream to Toulouse. Spatial variation is noticed along the

river, with a link to the presence of urbanization very clear effect. The data fluctuate on the stretch that crosses the city, highlighting an inhomogeneous distribution of particulate pollutants.

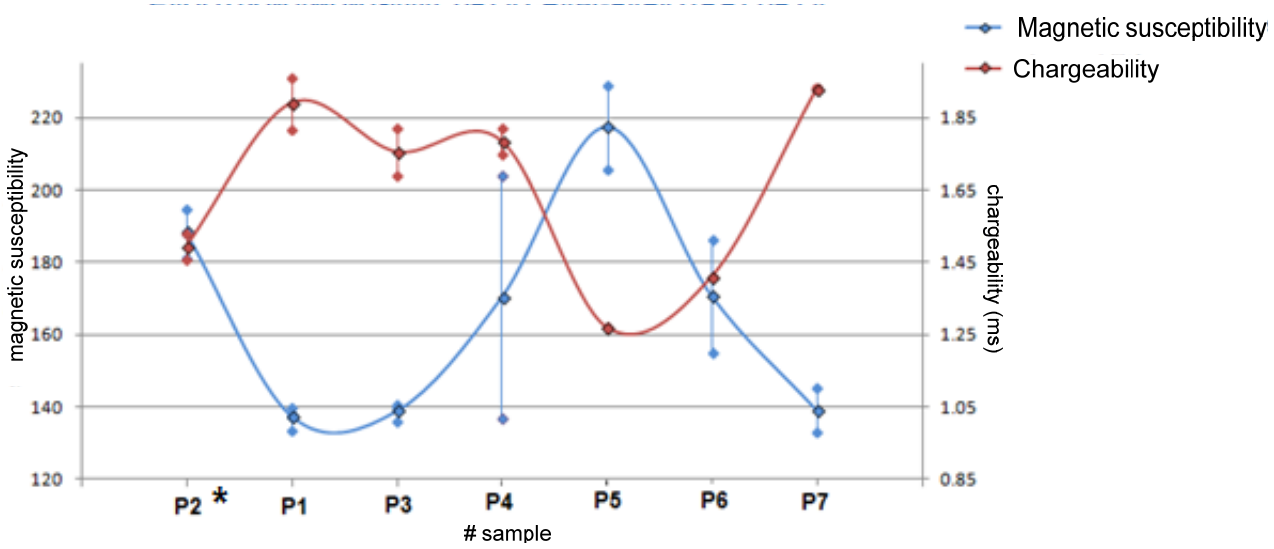

Fig. 2: Measures chargeability and magnetic susceptibility of samples taken along the Garonne (upstream is left downstream right)

Contrary to our expectations, the two geophysical parameters are anti-correlated with an increase in IP in the city, while the susceptibility decreases. The nature of the particles responsible for this phenomenon is certainly the cause of these variations.

Finally, far downstream of Toulouse (last sampling), the influence of urbanization has not decreased, which implies transportation over several km of leached particles.

The electron microscopic analysis was used to validate the presence of numerous anthropogenic particles. However, no precise quantitative estimate could be made, nor on the spatial variations of the quantities of these particles.

Conclusion

This first study validates the use of chargeability and magnetic susceptibility for monitoring pollution in river sediments, even in the case of a weakly polluted river as the Garonne. Characterization and quantification of particles involved remains to be done to identify the sources of the observed phenomenon.

Reference

Truchot, C., Chocat, B., Chatelain, M., Mares, A. and Mouchel, J.M., 1994. La pollution des rejets urbains par temps de pluie: impacts sur les milieux récepteurs. *La houille blanche*, 1-2, 97-105.