Tracking sources of PM2.5 and PM10 in urban atmospheres: A view through a multi-isotope approach

David Widory[1]

[1] BRGM

Due to their relatively high concentration in urban environments (from 10 to more than 50 µg.m-3), atmospheric particles have potential damaging effects on the Public Health. Hence, the development of measures dealing with fine particulate matter is considered a priority by the EU Clean Air For Europe (CAFE) Programme. Still, the origin of these airborne particles is subject to debate, as classical methods showed their limitations. To clearly identify and appraise the respective contributions of each type of aerosol source, a new method based on a multi-isotope approach (carbon, nitrogen, lead and strontium systematics) is proposed.

This is a two-steps study:

1)First, we isotopically characterize both the organic and inorganic phases of PM10 (measurements made on PM2 .5 will also be discussed) from pollution sources exhausts (with the example of Paris) in order to identify each one of them by distinctive isotope signatures (similar to isotope fingerprints).

2)Secondly, the comparison with the isotope characterization from ambient air samples allows then to identify the main source(s) of pollution, as well as to (semi-)quantify their respective contributions.

Results show that all of the aforementioned isotope systematics clearly discriminate the different sources of aerosols in the urban atmosphere. In particular combustion installations using different kind of fuels , as well as incineration units, display isotope signatures significantly different from the other types of sources.

On the other hand, in the first 20 meters above the ground in Paris, carbon results from ambient air samples show the predominance of road traffic as the principal vector of the organic phase (among which diesel emissions play a major role), while industry is the main source of the inorganic phase. This trend appears constant along the year, i.e. no clear variations between summer and winter seasons. Both strontium and lead also plead in favor of, under specific meteorological conditions, a non-negligible part of the PM10 originating from natural sources outside the city. The study of nitrogen isotopes gives clear indications on the origin of both primary and secondary generations of nitrogen (the latest resulting of the degradation of atmospheric NOx) in particles.

These first results indicate that the use of isotopes as tracers of aerosols in the atmosphere is conclusive, and open a large field of isotopic research in the domain of atmospheric pollution.