Chemical and isotopical characterisation of atmospheric pollution from urban and rural environments of the Rhine Valley (PCBs, trace elements and Sr-, Nd- and Pb- isotope determinations)

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Atmosheric samples (gas and particulate matter (PM)) have been collected in the urban environment of the cities of Strasbourg and Kehl and in the rural environment of the Vosges mountains. For sampling of gas phase pollutants and particles two different passive sampler devices have been applied (PAS and Sigma-2, respectively). The PAS has been used for gas phase Polychlorinated Biphenyls (PCBs) sampling and is based on the passive adsorption of gas phase pollutants onto XAD-2 resin. The Sigma-2 sampler is based on the sedimentation principle (Stoke's law), collects particles in the size range 2.5-100 μm and allows the calculation of ambient air concentration. The sampler is mainly used for routine air quality measurements in German health and recreation resorts and in this field study the first time for collection of samples for subsequent trace element and isotope analysis. The collection time for the Sigma-2 and PAS are four and two weeks, respectively. Major and trace elements have been analyzed by ICP-MS and the Sr, Nd and Pb isotope ratios by a sector field MC-ICP-MS (Neptune) while PCBs were ASE extracted and analysed by GC-ECD. The aerosol data are compared with those from tree barks which have previously been used successfully as biomonitors of atmospheric pollution (Lahd Geagea et al. 2008)[1]. The outer 1 mm thick part of the bark has been analyzed corresponding to about 2 to 8 years of accumulation. Some of the trace elements (Cr, Ni and Mo) of the aerosol samples are strongly (up to 1000 times) enriched compared to average "upper continental crust (UCC)". Normalization to a « natural » sample with an atmospheric baseline composition allows to identify industrial contributions: transition metals (Cr, Mn, Fe, Co, Ni, Zn, Mo, Cd), Ba and Pb appear to be important elements in steel plant and incinerator (chemical waste) emissions. Similarly enrichment in light rare earth elements (La, Pr, Nd) is observable. The enrichments increase with decreasing distance from traffic and the principal industrial activities. UCC normalized trace element distribution patterns of aerosols and tree bark are very similar. ^{206}Pb/^{207}Pb and ^{208}Pb/^{207}Pb isotope ratios of today's PM vary within a small range and are very similar to those of steel plant, waste incinerator and thermal power plant emissions. Older aerosols (collected 1995, before leaded petrol was phased out), have significantly lower Pb isotope ratios pointing to the impact of leaded gasoline at that time. Tree bark monitoring covers a 10-y history of Pb emissions. Combining Pb isotope ratios with ^{87}Sr/^{86}Sr and ^{143}Nd/^{144}Nd allows for a much better discrimination between the different anthropogenic emissions and might be suitable for source apportionments. PCBs concentrations of tree bark or PAS samples are generally correlated with trace element contents determined on the same material. PAS/tree bark PCBs ratio allows distinguishing between current or past contamination.

[1]Lahd Geagea, M., Stille, P., Gauthier-Lafaye, F., Perrone, Th., Aubert, D. 2008. Baseline determination of the atmospheric Pb, Sr and Nd isotopic compositions in the Rhine valley, Vosges mountains (France) and the Central Swiss Alps. *Applied Geochemistry*, 23, 1703-1714.