Geophysical Research Abstracts
Vol. 17, EGU2015-11027, 2015
EGU General Assembly 2015

Suspended particulate composition: evolution along a river linear and influence of regime flow

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Suspended Particulate Matters are recognized to play a crucial role in the transport and fate of chemicals like trace metal elements. The affinity of trace metals with natural SPM is influenced by (i) the nature of metal (ii) physical–chemical conditions of the water column (iii) SPM physical characteristics (grain size, surface area) (iiii) SPM chemical characteristics (elemental composition, mineralogy, organic composition). Some authors observed that the SPM composition was the predominant factor controlling the affinity of trace metals with natural SPM.

One purpose of this work is to follow the physical and chemical characteristics of SPM along the river linear in order to better understand the affinity between SPM and heavy metals. One other purpose is to study the influence of regime flow on SPM physical and chemical composition in order to detect any variation of SPM composition with regime flow.

SPM were sampled along Moselle river (North East of France) following an urbanization gradient. Two tributaries were also sampled, the Madon river which drains an agricultural catchment and the Fensch stream which flows through an ancient steel-making basin. SPM were sampled several times during high flow and low flow. Particulate matter was extracted on field using continuous flow field centrifuge. Frozen-dried samples were then characterized in terms of size distribution, elemental composition (ICP – AES, ICP – MS), mineralogy (XRD, FTIR, SEM, TEM), surface properties (gas adsorption techniques) and organic composition (Py-GC-MS and GC-MS).

Grain size distribution evidenced the presence of coarser particles during high flow but no difference in the grain size distribution could be evidenced between the different stations. The grain size distribution of collected SPM appeared globally identical, although the increase of conductivity due to the junction of Meurthe river .

In terms of composition, major element contents in SPM are characterized by the predominance of Si, Al and Fe due to the presence of aluminosilicate particles (clay minerals mainly). The “steel-making” tributary, Fensch stream, was shown to be strongly impacted by human activities and the SPM collected in this highly impacted river are specifically constituted of Fe, Mn and Ca and display low amounts of Si and Al. Study of SPM mineralogy revealed the presence of phyllosilicates (clays such as illites, smectites and interlayered illite/smectite being predominant), quartz, carbonate (calcite) and iron oxihydroxides (amorphous).

Concerning trace metal content, few trace elements were present at contents higher than the geochemical background: Zn, Pb, Cr, Cd. Zn content in SPM does not show a clear trend from upstream to downstream.

The organic matter characterization permitted to identify four families: the fatty acids, nitrogen compounds, lignin compounds and other compounds. Molecular analysis of organic matter confirms the stability of SPM composition during high flow and low flow and upon the river linear.