Colloid-Facilitated Transport of Pollutants: Phenomena and Modeling

D. GROLIMUND[1], K. BARMETTLER[2], AND M. BORKOVEC[3]

[1]Swiss Light Source and Waste Management Laboratory, Paul Scherrer Institute, CH-5232 Villigen, Switzerland
[2]Swiss Federal Institute of Technology Zurich, Institute of Terrestrial Ecology, CH-8652 Schlieren, Switzerland
[3]Analytical and Biophysical Environmental Chemistry, University of Geneva, CH-1211 Geneva 4, Switzerland

Colloidal particles are being increasingly recognized as key components within geologic and aquatic environments. Such particles are involved in a broad variety of environmentally relevant processes. In subsurface systems, however, a considerable number of these processes have hazardous consequences. For example, colloidal particles are suspected to contribute to the mobility of pollutants by acting as mobile carriers. Recent field and laboratory studies pointed out the possible importance of this additional transport mechanism [e.g., 1, 2]. Therefore, considering potential hazardous incidents due to mobilized colloidal particles should represent a critical task in risk assessment of any subsurface contamination problem, in the development of remediation strategies, as well as in recharge and waste water management. However, available knowledge concerning the physical and chemical characteristics of such environmental colloids as well as the processes determining their release and mobility in natural porous media is still limited.

In order to judge or predict the susceptibility of a subsurface system to the phenomena of enhanced contaminant transport by mobile colloidal particles, a detailed understanding of the following processes is required: (i) the generation of mobile colloidal particles, (ii) the life-time of these particles within the system, and (iii) the association of the contaminant with the mobile particles.

In the present paper various aspects of the diverse problem of enhanced contaminant transport by *in-situ* mobilized colloid particles will be addressed. The discussion will be based on a comprehensive set of laboratory-scale experiments, which were performed in order to investigate relevant fundamental processes such as particle mobilization, particle deposition and transport as well as multicomponent (colloid-facilitated) contaminant transport phenomena. The resulting knowledge about mechanism and dynamics of each process obtained by these individual experimental investigations were compiled and incorporated into an extended contaminant transport model. This model was used to simulate and analyze or predict complex contaminant transport experiments where *in-situ* mobilized colloidal particles have been proven to be a dominant transport pathway for environmental pollutants.

[1] Grolimund D. et al., (1996), *Env. Sci. Technol.*, **30**, 3118.
[2] Kersting A.B. et al., (1999), Nature, **397**, 56.

Spatial and temporal trends for sediment-associated metal contamination in the Seine River Basin (France)

C. GROSBOIS [1], M. MEYBECK [2], A. HOROWITZ [3]

1. Laboratoire LASEH, Univ. de Limoges. 123 av. A. Thomas, Limoges, France (cecile.grosbois@unilim.fr)
2. Laboratoire Sisyphe, UMR 1367, 4 Place Jussieu, Paris, France (meybeck@biogeodis.jussieu.fr)
3. US Geological Survey, 3039 Amwiler Road, Atlanta, GA USA (horowitz@usgs.gov)

Since 1981, a multiple sample media approach (bed sediments-BS, recent flood deposits-RFD, trapped and filtered suspended matter-SPM).has been used to determine spatial and temporal sediment-associated trace element trends. These programs span more than 20 years, and cover the entire Seine River Basin (SRB). The SRB displays a wide range of sediment-associated trace element concentrations. In the early 1980's, the SRB probably was among one of the most anthropogenically impacted basins in the world. Trace element maxima, observed in BS surveys, correspond to contamination factors of 247 for Hg, 93 for Cd, 57 for Cu, 30 for Pb and 22 for Zn, throughtout the SRB.m Since the early 1980's, there has been a marked decline in the concentrations of all these trace elements, both upstream and downstream of Paris (Figure 1) as well as at the mouth of the Oise River. This substantial improvement probably can be attributed to a generalized reduction in trace element inputs from both industrial and domestic sources. One of the most marked examples of this reduction was observed in the trace element composition of discharges from the Seine Aval plant, the world's 2nd largest wastewater treatment facility. Upstream of Paris and at the mouth of the Marne River, temporal declines in sediment-associated trace element concentrations are not as marked. This probably results because anthropogenic impacts (population densities, industrialization, agriculture impacts) always were lower in this area of the SRB, relative to the Metropolitan Paris.

Figure 1: Temporal changes in sediment-associated Zn concentrations (mg/kg) at Poses, the last lock on the Seine River prior to the estuary, in various sample media [SPM (♦), BS (stars), RFD (○)]