Geophysical Research Abstracts, Vol. 8, 02292, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02292

Varying redox conditions changes metal behavior due to microbial activities

K. Vanbroekhoven (1), S. Van Roy (1), C. Gielen (1), M. Maesen (1), L. Diels (1), P. Seuntjens (2)

(1) Environmental and Process Technology, Flemish Institute for Technological Research, Belgium, (2) Integral Environmental Studies, Flemish Institute for Technological Research, Belgium (karolien.vanbroekhoven@vito.be / Phone: +32 14 33 51 66)

In the last century, large amounts of inorganic contaminants have accumulated in areas near river basins like the Meuse river system due to industrial activities. An old coal factory located at the border of the city of Flemalle (near Liege) is heavily contaminated by both inorganic compounds such as metals and organics and located on the bank of the Meuse river. The Dommel on the other hand is a tributary of the Meuse that flows through a zinc producing industrial area. For the last hundred years, these activities, present on both sides of the Belgian-Dutch border, have led to atmospheric deposition of zinc and cadmium on agricultural land and nature reserves.

Understanding the properties and the functional role of soils in relation to the behaviour and fate of pollutants is of utmost importance in view of climate changes, specifically when realising how scarce and valuable both groundwater and surface water are becoming. More specifically, the transfer and the chemical stability of **metal contaminants** in soils and sediments are controlled by a complex series of biogeochemical processes depending on variables like pH, clay content, redox… Unravelling the interactions between biological and chemical processes and looking at the combined effects under varying redox conditions in the saturated zone were the aim of this work. Therefore, a series of batch experiments was performed to get an idea of the impact of microbiology on the fate of metals in saturated soil systems representing two different areas, or two different aquifer types (selected as indicated above) along the Meuse river system and its tributaries.

The study focused on metal behavior along a redox gradient ranging from oxic

aquifers up to sulfate reducing conditions. The description of **metal behavior along redox gradients** is important for predicting metal transport from unsaturated to saturated zones and from aquifers to surface waters. Metal behavior may also be influenced by nitrate infiltration in the saturated zone due to excessive soil fertilization. Different conditions were selected to study the impact of redox gradients, i.e., varying concentrations of oxygen, nitrate and sulfate. While the original conditions for Dommel and Flemalle differ significantly in terms of anionic/cationic elements, these initial characteristics are reflected in the results of biogeochemical experiments. Groundwater samples of Dommel were low in sulphate concentrations ($<$ 50 ppm) resulting in denitrification as the main microbial activity in presence of TOC. Consequently, Zn and Cd could be removed for Dommel containing microcosms under denitrifying conditions, most likely due to pH increases. Similar results were found for Flémalle, but sulfate reducing conditions dominated (400 ppm SO_4^{2-}). These sulfate reducing conditions were visually translated by formation of black precipitates. Clearly, fate of metals will only be impacted by the biological metabolism in the presence of C-source (TOC). While high Kd values are found under these conditions, we assume that decay of organic matter or impact of root exudates that infiltrate into the groundwater could have major impacts on metal sorption/desorption behavior.