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Bioavailability and biodegradability of organic matter associated to microbial activities in river sediments

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The Moselle River basin (north-east of France) is under the impact of different anthropic activities, ranging from forestry and agriculture, to industrial and urban sites. They can affect soils, sediments and water quality and resources at different levels. The purpose of this study is to evaluate the role of microbial activity on the biodegradability of river sediments organic matter, and its impact on the behavior and availability of nutrients.

Six river sediments were sampled during the fall 2004. Five samples were taken in the upper and middle part of Moselle River (low to high urbanization) and one in the Fensch River near the Moselle confluence (mixed high pollution from mainly obsolete industrial zones). The samples were air-dried at low temperature, sieved at 2 mm and analyzed for their main chemical and physicochemical characteristics. Incubation experiments were performed in batch devices during 30 days, in aerobic and anaerobic conditions, to characterize the influence of different redox conditions occurring in river sediments. Abiotic controls have also been done. At 0, 15 and 30 days, the following parameters were measured to evaluate C, N, P, S mineralization and nutrients behaviour: CO_2 production, Dissolved Organic Carbon (DOC), pH, Eh, anions and main cations in solution. In complement water soluble organic matters (WSOM) of two sediments having similar organic carbon content but one being polluted and the other unpolluted were studied for their biodegradability.

The sediment content in organic matter is affected by different parameters such as weirs and low flow streams, which increase accumulation of fine particles and organic matter by sedimentation. The amount of “bioavailable” carbon (solubilized and min-

eralized) is not significantly different in aerobic and anaerobic conditions. Aerobic conditions enhance organic matter mineralization while anaerobic conditions improve DOC release. Biodegradability coefficients can be estimated using mineralization and solubilization yields of organic carbon. Nitrogen nitrification and mineralization coefficients were also determined. Biodegradation cannot be related accurately with organic matter content and C/N ratio. Large amounts of available nitrogen (NH_4^+, NO_3^- mainly) are released in both aerobic and anaerobic conditions presenting different rates and coefficients. N mineralization is improved by anaerobic conditions due to ammonification. Ammonification occurred in all sediments, whereas nitrification appears only in some samples. Phosphorus is released only for some sediments and only in anaerobic conditions. Sulfate production or consumption is related to redox conditions and is a good indicator of redox activities.

The water soluble organic matter considered as available organic matter is relatively larger and more biodegradable in the unpolluted than in the polluted sediments. Redox conditions seems to have no influence on total available (e. g. mineralized and soluble) organic matter but control the yield and pathways of C, N, S and P mineralization. Nutrient availability and release are under the dependence and control of the nature of organic matter and of the oxic and anoxic conditions of the environment but interactions, which have to be better defined, are also suggested between microbial activities, nutrient release and availability. Production of inhibitory or recalcitrant substances may also occur. Finally results provide an insight on the carbon cycling and its coupling with cycling and behaviour of N, P, S and associated compounds in river sediments.