Sediment Quality and Impact Assessment

Synthesis of the SedNet Work Package 3 Outcomes

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1 Key Recommendation

It has been recognized that adequate monitoring and analytical concepts are necessary to monitor sediment quality. Without appropriate tools it will not be possible to investigate behaviour, environmental stability, bio-availability and fate of pollutants in sediments.

General remarks and recommendations in monitoring programs to investigate sediment quality are listed in the next section.

2 General Remarks and Recommendations

2.1 Selection of target compounds

We recommend that the selection of target compounds to be monitored in sediments should be based on:

(1) Persistence;
(2) Bioaccumulation/adsorption;
(3) Toxicity;
(4) Relevance at the large scale (river basin);
(5) High fluxes (tendency to increase concentrations/fluxes on the long term basis);
(6) Compounds already on the priority lists or possible candidates also called emerging contaminants (the Water Framework Directive (WFD) list of priority substances is amendable for revision and addition of new contaminants each four years. Such addition or replacement of pollutants will be based on the results of present and future monitoring programs and on the results achieved by RTD projects where identification of new or emerging contaminants takes place.

2.2 Monitoring of sediments and/or suspended solids

We recommend undertaking monitoring of sediments and/or suspended solids. Substances which tend to accumulate in the geo-sphere and are transported bound to particles may to be better measured in the suspended matter than in the water phase, which is particularly important for some new groups of compounds included in WFD, such as flame retardants (PBDEs). It is clear that transfer of contaminants from the sediments to the water column through processes of diffusion, advection and sediment resuspension is a major factor. We recommend that a river monitoring plan should necessarily include that of the suspended matter in order to obtain a complementary picture of the pollution status of the whole river basin. In this respect we should add that contaminants in suspended sediments represent 'current' rather than historical pollution, as they will ultimately lead to 'new' deposits of contamination and newly settled material is the main food source for detritivorous benthic organisms.

2.3 Development of contaminant monitoring guidelines

We recommend the development of Guidelines for Monitoring Contaminants in Sediment in agreement with the EU WFD Expert Group on Analysis and Monitoring of Priority Substances (AMPS). One option could be to adopt these guidelines, with any modifications to account for applications to lakes, rivers, etc. The frequency of sediment monitoring should furthermore be specified, and could be once or twice per year to once every 5 to 10 years, depending upon the sedimentation rate. Sediment samples could be collected, randomly at the designated sampling point and the location of each recorded. Samples shall be collected at the same time of year, each sampling occasion, the time being chosen according to local circumstances, bearing in mind the aim of monitoring trends in the concentration of contaminants. The purpose of sediment monitoring guidelines is to assess long-term trends in impacts of anthropogenic pressure and to ensure no deterioration objective is reached and that comparable data are collected.

2.4 Assessment of bioavailable fraction of pollutants

Monitoring should include assessment of bioavailable fraction of pollutants (metal speciation, organics), in both the laboratory and the real field situations. It has been recognised that there is a lack of knowledge in the fundamental processes constituting bio-availability. In this respect there is a quest for chemical methodologies that can be used to mimic the biological availability of substances. A widely accepted concept is that addressing bioavailability of sediment-bound chemicals improves the assessment of their 'ecological risks'. In this context bioavailability is the key parameter to elucidate routes and pathways of contaminants from source (sediment) to targets (organisms, populations, ecosystems), which implies highly complex processes with a multitude of interactions between abiotic environment and the different parts of the biocenosis in sediments (different organisms from bacteria to fish). We recommend to use the following tools to assess the bioavailability:

(1) Biotic indices and the consideration of the bioavailable fraction of contaminants will improve the predictability of effects in the natural situations;
(2) Molecular methods will provide the opportunity to get *in situ* and on site information on the effects of contaminants on the structure and function of the biocoenosis;
(3) Mechanistic and field research is needed to derive applicable *in-situ* methods for assessment of bioavailability present at the contaminated site;
(4) Bioassays are needed to evaluate the bioavailability of ALL contaminants present, and thus not only the chemically analysed target compounds.

2.5 Impacts of the anthropogenic contamination on the ecosystem

However, while the negative effects of some anthropogenic chemicals are relatively wellcharacterised, such as the toxicity of lead, others are not well understood, or may not even have been identified. On the other hand, ecosystems can be resilient, and may be able to adapt to additions of toxic chemicals, or changes in their environment. For these reasons, chemical analysis is not necessarily a good predictor of environmental diagnostic and effects. Consequently, we recommend that the chemical analysis should not be used for deciding whether intervention in sediment quality is required, but rather, that the impacts of the anthropogenic contamination on the ecosystem should be the determining factor. There are two fundamental problems with this approach. Firstly, a local sediment ecosystem is unique and comprises thousands of species. It is impossible to test for effects on all of them, and the degree to which tests on selected species can be extrapolated to others, or the ecosystem as a whole, is perhaps as difficult as extrapolating effects from chemical analysis. Secondly, there are numerous effects that might occur, e.g., acute toxicity, sub-lethal toxicity effects, carcinogenicity, teratogenicity, mutagenicity, endocrine disruption, changes in metabolism or role in ecosystem, etc. The mechanisms for these effects can all be different, but they can all have an impact on ecosystem health and function.

2.6 Standardisation of monitoring and assessment tools

Although we have a large range of tools available for biological characterisation of sediments, for *in-situ* community structure evaluation, other in-vivo assays, such as *in situ* biological tests and direct toxicity assessment (DTA) and a range of in-vitro assays to check for endocrine effects and genotoxicity, we do not have a set rationale for what to use where and at present, tests do not give a clear indication of what factors may be causing effects (for clarification of cause-effect relationships the use of Toxicity Identification Evaluation (TIE) procedures maybe useful). The tools for sediment assessment are available and we recommend the need to use coherent international standards, already implemented and accepted by industry and governmental authorities, that will give a clear picture for management at landscape scale and ecological relevant handling of sediments. Thus, it is important to use the advantage of the international standards e.g. after ISO (International Organisation for Standardisation) or CEN (European Organisation for Standardisation) or national well established standard protocols, e.g. under AFNOR (Association Francaise de Normalisation), BSI (British Standard Institute), DIN (German Organisation for Standardisation) etc. all those standards are formed by ISO-Working Groups and validation studies into ISO- and CEN-Standards.