The German Environmental Specimen Bank. Sampling, processing, and archiving sediment and suspended particulate matter

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Abstract:

Goal, Scope and Background. The European Water Framework Directive implies a risk based sediment management. In this approach sediments are recognised as secondary sources of contaminants, and suspended particulate matter (SPM) as the carrier. For that reason the concept of the German Environmental Specimen Bank (ESB) includes the establishment of these specimens. The ESB is characterised by a high quality assurance system of standard operation procedures (SOP) to preserve the integrity of the specimens under cryogenic conditions for transportation, storage and handling. The aim of this study was (1) the development and validation of SOPs for the collection of sediment and SPM, and (2) the adaptation and standardisation of sampling techniques for the ESB. This paper provides information about sediment and SPM as new specimens in the ESB.

Methods. A redesigned freeze-coring device was tested and applied to collect unconsolidated sediments at the fresh water sampling sites of the German ESB. Liquid nitrogen was used as a cooling agent. Sediment cores were cut on site using a stainless steel saw or an angle grinder with a diamond blade, stored in stainless steel containers and transported to the depot of the ESB inside a nitrogen vapour freezer. SPM was collected using passive sedimentation boxes (SBs). The SBs were installed permanently in surface waters or monitoring stations. Sampling of SPM was performed monthly and the SPM was subsequently frozen on site, stored in stainless steel containers and transported to the depot of the ESB in a nitrogen vapour freezer. At two locations the comparability of this method with sampling using a continuous-flow centrifuge Padberg Z61 was investigated.

Results and Discussion. The sediments at almost all fluvial sampling sites of the ESB are sapropel or Gyttja type. The use of a freeze-coring device allowed sampling of these unconsolidated sediments under the conditions of ESB. The device was not applicable at two locations due to tidal influence and fine-grained sediments, respectively due to the depth in case of Lake Belau (~28 m). In these cases piston corers were used for sediment sampling. The collection of time-integrated SPM samples using SBs achieves the approach of the ESB. In comparison, the Padberg Z61 provides only samples, which are representative for the short collection period of 8-10 h (snapshot). A shortcoming of SBs is a possible alteration of SPM during the sampling period of about 4 weeks. However, alteration of the samples is not as evident as shorter collection periods and usage of a Padberg Z61 causes technical and economic difficulties.

Conclusions. The modified freeze-coring device and the sedimentation boxes are applicable for the collection of sediment and SPM samples within the framework of the ESB. The chosen sampling and handling techniques attain the requirements of the ESB. Consequently, routine collection and storage of sediment cores and SPM started in 2005. According to our knowledge, the German ESB is the first of all specimen banks worldwide that routinely collects and stores SPM and that applies in situ freeze-coring to collect sediment cores.

Perspectives. The collection and storage of sediments and SPM as new specimens in the ESB enhances the possibilities to control the efficacy of the European Water Framework Directive, REACh, and similar regulations and to take further action.