Geophysical Research Abstracts, Vol. 7, 10688, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10688

Long-term Monitoring of Radionuclides in the Austrian Danube Section: Results and Highlights

F.-J. Maringer, **M. Hrachowitz**, V. Gruber

University of Natural Resources and Applied Life Sciences (BOKU), Department of Forest- and Soil Sciences, Institute of Soil Science, Vienna, Austria (markus.hrachowitz@boku.ac.at / Phone: +43 50550 6517)

The Austrian section of the Danube has been monitored since 1986 in order to investigate the behaviour of natural as well as anthropogenic derived radionuclides in the river. The project started in the month after the Chernobyl incident, as parts of Austria have been heavily contaminated by Chernobyl fallout. The monitoring, though, did not only emphasise on artificial fallout radionuclides like ^{137}Cs but also took into account the presence of naturally derived radionuclides such as ^{7}Be and ^{210}Pb.

The aim of the project is to learn more about long-term behaviour of radionuclides in rivers and their relations to climate and radionuclides in soil.

In order to obtain a comprehensive data set, it was necessary to carry out a continuous and temporal well defined monitoring scheme along the Danube. Sediment samples have been taken from the cooling circuits of the power stations at the locations Ottensheim/Wilhering (km 2146,7) and Wallsee/Mitterkirchen (km 2094,5) and Greifenstein (km 1949,2) on a monthly basis. Water samples, including sediment load, have also been taken on a monthly basis from 1993 to 1995 in Ottensheim and Wallsee and from 1993 to 2004 in Greifenstein. High water periods have been documented by additional samples taken each 24 hours during a high water event.

Considering grain size effects and the hydrological situation, the data have been analysed and interpreted.

Sediment samples. Peak ^{137}Cs activity concentrations in the sediment have been reached in the months following the Chernobyl disaster. The subsequent decrease of activity concentrations can be approximated by an exponential function for the first two years. This rather rapid decay is characterised by an ecological half-life of around 5 months. From 1988 on, the decline of ^{137}Cs activity concentration describes a much more flat, though still exponential graph, suggesting an ecological half-life of around 5 years. This change might indicate an increase in ^{137}Cs adsorption processes in the catchment soil particles in the first weeks/ months after the environmental contamination.

Correlating the actually measured ^{137}Cs activity concentration of the sediment at all sampling sites to the average monthly discharge shows good results. This meets the original expectations, as a higher runoff would cause less fine sediment particles being deposited at the bottom of the river.

Moreover, a seasonal variability with high activity concentrations during winter and low concentrations during summer was detected and correlated to the respective discharge, showing a strong correlation, because more and more intense precipitation as well as runoff are recorded during summer, resulting in a higher amount of coarse grained particles, which bind less ^{137}Cs than fine grained particles, to be moved into the river.

Suspended samples. In contrast to sediment samples no trend for a change in activity concentration can be identified, which is rather surprising as the activity concentration of soil transported into rivers is over the time decreased by physical decay as well as erosion.

Similar as for the sediment samples, a close relation between average monthly discharge and activity concentration was shown at all three sampling sites. It, however, has to be noted, that the satisfactory correlation results largely depend upon high water events, while during normal water periods, only somewhat poorer correlation could have been established.

The highest activity concentration of water by radionuclides bound to suspended particles can be found during summer and the lowest during winter. That result seems to be sensible, taking into account the increased discharge during summer and the reduced discharge during winter. High flow depth and high flow velocity during summer season cause more particles to be suspended and transported in the water. The lowered flowing depth and flowing velocity in winter prevent suspended particles in the water – the particles are deposited to the bottom.

Radionuclides dissolved in water. As for suspended particles, no significant temporal trend of change in the activity concentration can be identified for dissolved ^{137}Cs. Concentrations are found uniformly distributed at all three sampling sites. No significant correlation between runoff, season or sampling point and activity concentration has been detected. Generally it can assumed, that the activity concentration remains constant over time as well as with different ambient conditions such as changing runoff.

The long monitoring period provides a data set that can serve for various purposes in science as well as in river management. Firstly the nature and behaviour of radionuclides themselves can be studied more extensively, relying on a long-term data background. Secondly, the data might be used for dating river sediment as well as for determining the provenance of the sediment, using their respective radionuclide signature. Both applications can be important tools for reservoir management, floodplain management and erosion control.