On the radioecology of the River Danube – a new approach for dating solid particles

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With 6 figures in the text

Abstract

Results are presented from current research on the characterisation of the moment in time when solid particles entering surface waters are formed, based on radioecological investigations of some artificial and natural radionuclides (Be-7, Cs-137, Pb-210). These radionuclides imprint a radiometric time-stamp on solid particles when they are washed from soils into surface waters. Due to the special mineralogical composition of the particles, strong binding mechanisms between the radionuclides and the solids conserve the event marker throughout the transport phase in the surface-water environment. When evaluating radiometric data from samples of solid particles, ecological parameters that influence their distribution must be taken into account, the most important being grain size distribution. These interactions and the general possibilities and limits for using this new dating concept are discussed.

Introduction

Due to radioactive decay – expressed in the exponential law of decreasing activity – the natural and artificial radiation environment contains information on the times taken by ecological processes. In the case of a large river ecology system, radionuclides produced naturally in the atmosphere or geosphere (for example Be-7, Pb-210) reach the fluvial compartments (water column, suspended and sedimented solids) after some transition process in the catchment area. In the case of radionuclides of artificial origin similar processes, as for natural radionuclides, come into question. But in general there is a difference in the input functions: whereas natural radionuclides usually reach the surface water system continuously, in seasonal periods of intensity the environmental contamination with artificial radioactivity generally happens at “single” moments in time.

One of the motives for starting these investigations were the results of the long-term decrease of Cs-137-activity in sediment samples collected monthly in the Danube (Fig. 1). Before the environmental contamination of Europe with radiocaesium due to the nuclear reactor accident in Chernobyl/SSR, the sediments of the Danube in Austria had Cs-137-activity concentrations of only a few Bq/kg (RANK et al. 1990) as a consequence of atmospheric atomic weapon tests.

The results of some other investigations deal with mineralogical characteristics and distribution of solid particles of the Austrian part of the Danube (KRALIK & SAGER 1986).