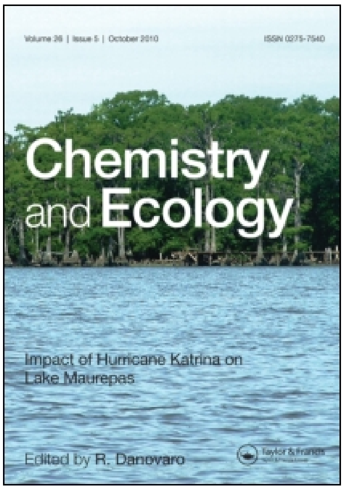

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Distribution and Migration of some Metals in the Water–Sediment System Using Radiotracers

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The knowledge of heavy metals and related radionuclide distribution, and accumulation among the different components of a fresh water ecosystem, plays a relevant role in environmental studies. In the present study reported here the behaviour of ^{60}Co, ^{134}Cs and ^{54}Mn was investigated in a water–sediment system. Water and sediment samples were obtained from an artificial channel, derived from the Po river near Serafini Island (middle course). It was characterized by a very low water flow.

Soon after collection, sediment samples were centrifuged to separate the water in the presence of air or nitrogen. Fresh overlying and pore waters, after filtration with 0.45 μm membrane filters and acidification, were submitted to metals determination by atomic absorption spectroscopy. Anion determinations were carried out before filtration by ion chromatography.

Water analyses show major differences between fresh and pore water samples, as already reported in sea and lake environment investigations (Boniforti *et al*, 1980).

Manganese and iron content in water samples were one order of

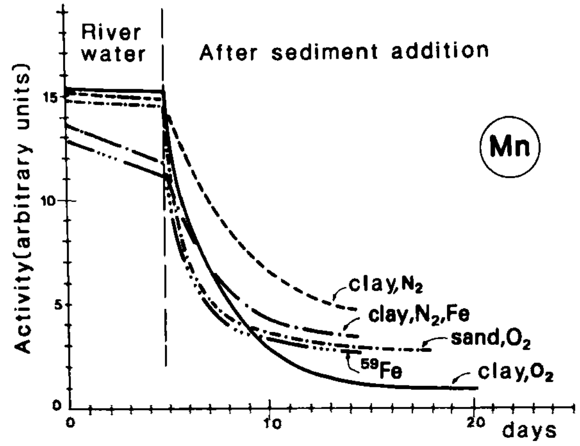

FIGURE 1 ^{54}Mn removal from fresh water and from water-sediment system as function of time under different experimental conditions. ^{59}Fe behaviour in N_2 atmosphere is also shown.

magnitude higher than in fresh water samples, copper and potassium content four times higher. On the other hand sulphate ion concentrations are lower in pore water samples. The observed trends may be ascribed to the occurrence of reducing conditions in the pore water as it is well known that iron and manganese in their

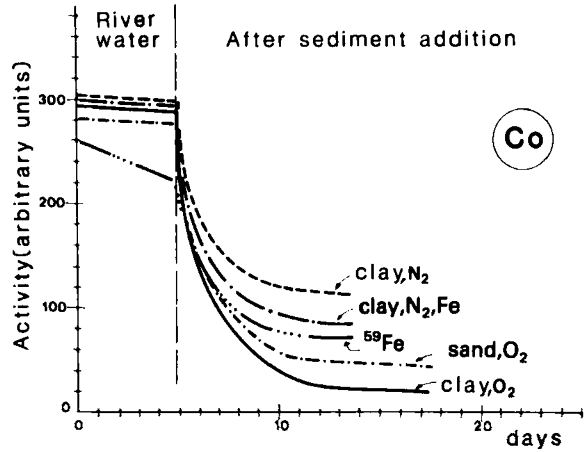

FIGURE 2 ^{60}Co removal from fresh water and from water-sediment system as function of time under different experimental conditions. ^{59}Fe behaviour in N_2 atmosphere is also shown.

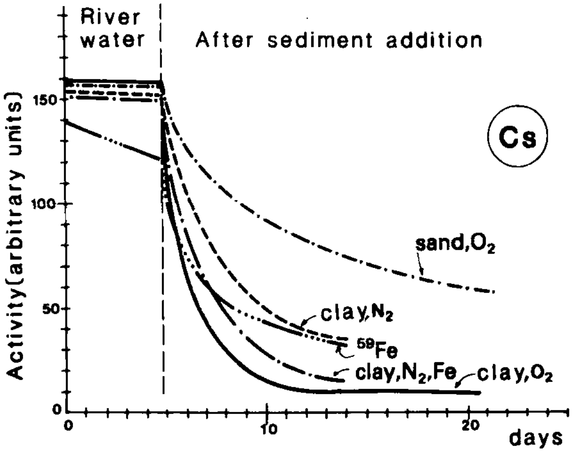

FIGURE 3 ^{137}Cs removal from fresh water and from water-sediment system as function of time under different experimental conditions. ^{59}Fe behaviour in N_2 atmosphere is also shown.

lowest oxidation state are more soluble. The higher organic matter content in pore water (Elderfield, 1981) accounts for the higher copper content. The higher potassium content is due to exchange reactions between pore water and sediment minerals (Aston and Duursma, 1973).

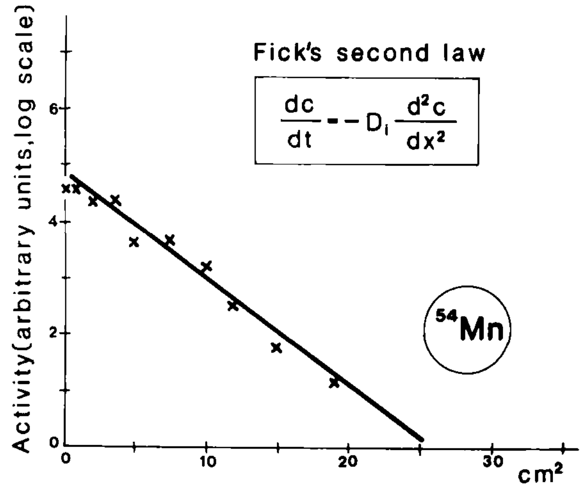

FIGURE 4 Variation of log activity versus square of penetration length for ^{54}Mn.

The use of radiotracers in environmental studies assumes an identical behaviour of added radiotracers and the related stable nuclides present in the sample under investigation. The occurrence of the identical behaviour was verified by the dialysis method.

In order to evaluate the transfer of added radionuclides from water to sediment, the following experiments were carried out according to Duursma (1970): (1) in presence of air with clay sediment (dissolved oxygen about 10 mg l^{-1}); (2) in presence of air with sandy sediment (dissolved oxygen about 10 mg l^{-1}); (3) in presence of nitrogen with clay sediment (dissolved oxygen less than 1 mg l^{-1}); (4) in presence of nitrogen with clay sediment (dissolved oxygen less than 1 mg l^{-1}) and addition of neutron irradiated Fe.

The results of these experiments are given in Figures 1, 2 and 3. The reported trends indicate that, in the presence of nitrogen, the ^{54}Mn and ^{60}Co transfer rate from water to the sediment is lower than in the presence of air.

The addition of iron in the experiments with a nitrogen atmosphere enhances the radionuclide transfer to sediment. In experiments in the presence of air, the addition of iron causes some removal of radionuclides from solution even before sediment insertion.

The mobility of ^{54}Mn, ^{60}Co and ^{134}Cs within the sediment sample was investigated in the experiments in the presence of air with clay sediments. Results indicate that the manganese penetration mechanism follows the laws of diffusion (Figure 4). Moreover the diffusion coefficients, obtained at different time intervals as given in Table I, are in good agreement with those reported for manganese in Rhone river sediments (Ijvin *et al,* 1973).

The mobility of ^{134}Cs and ^{60}Co seems to be affected by other

TABLE I
Diffusion coefficients obtained at different time intervals for ^{54}Mn

Test	Time interval from start (days)	Diffusion coefficient (cm^2/day)
1	19	1.3×10^{-2}
2	55	1.4×10^{-2}
3	103	1.3×10^{-2}
4	155	2.4×10^{-2}

processes other than diffusion. In addition caesium adsorption on sediment is affected by the sediment mineral composition.

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