CONTENT OF THE ^{40}K, ^{232}TH, ^{226}RA, ^{238}U & ^{137}CS IN THE RECENT SEDIMENTS OF THE KRKA RIVER ESTUARY

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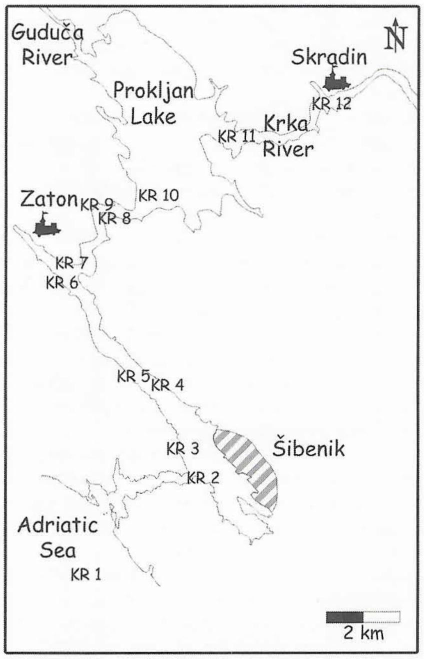
Abstract
A spatial radionuclide distribution in recent estuarine sediments in the Krka River Estuary was studied. Human activities affected a natural geochemical equilibrium of radionuclides in the area studied. The sediment samples have been analysed during the past two years and the activities of ^{40}K, ^{232}Th, ^{226}Ra, ^{238}U and ^{137}Cs were determined by a gamma-spectrometry method. The radionuclide distribution data indicate a different sedimentation rates of the marine and/or terrigenous origin. A difference in the transport rates of the dissolved and suspended material is clearly indicated by the ^{137}Cs and ^{40}K contents in the sediments at the upper estuary.

Keywords: the Krka River Estuary, sediments, radionuclide distribution, gamma-spectrometry

Introduction



A clastic material input into the eastern Adriatic Sea (the Croatian coast) is much smaller than that in the western side of the Adriatic Sea (the Italian coast), which can be attributed to the prevailing karstic character of the Croatian coast. There are no large rivers draining these terrains, and a relatively small quantities of the material carried by the eastern Adriatic rivers (Mirna, Raša, Zrmanja, Krka), are deposited in their estuaries. The Cetina and Neretva Rivers carry a significant quantities of the material, but due to the semi-closed nature of the Adriatic Sea, a recent sedimentation of the terrigenous material is restricted to a relatively small delta (the Neretva River) or an estuary (the Cetina River) sedimentation area. The content of naturally occurring radionuclides in the different types of a recent Adriatic Sea sediments has not been systematically studied, but some data were published elsewhere (1, 2).

Sampling and methods

The bottom sediment samples (the upper 5 cm of a sediment) were collected by a scuba diver using a hand-driven plexyglas corers, during the past two years at 12 locations in the Krka River Estuary. The samples were frozen at −18°C and kept until analyses. Prior to the gamma-spectrometry measurements, the sediment samples were thawed at room temperature and dried at 106°C during 24 hours, counted in a special vessels, sealed and stored for at least 4 weeks in order to allow a radioactivity disintegration of a gaseous ^{222}Rn. The samples were counted on a HPGe detector with a 8192 channel analyser. The system was calibrated using the standards supplied by Amersham International, IAEA-306 and IAEA-314. The spectra recoreded (80,000 seconds) were processed on a PC using a GENIE 2000 software. The activities of ^{40}K (1460.75 keV-peak), ^{137}Cs (661.6 keV-peak), ^{226}Ra (609.3 keV-peak of its ^{214}Bi progeny), ^{232}Th (911.1 keV-peak of its ^{228}Ac progeny) and ^{235}U (186 keV-peak (after the subtraction of the overlapping ^{226}Ra peak)) were calculated. The activities of ^{238}U were calculated from the ^{235}U activity assuming the ^{235}U/^{238}U activity ratio of 0.046.

Results and discussion

The lowest concentrations of all naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U and ^{226}Ra) as well as an anthropogenic radionucleide (^{137}Cs) were obtained at the station KR-1. These activities correspond to the sand and the silts which are mostly spread along the Croatian coast and represent a typical values for the marine carbonate sedimentation (1, 2). The activities of ^{40}K are found to be elevated towards the Skradinski Buk waterfalls. However, the highest activities were found at the station KR-10 (the Prokljan Lake), which decreased towards the station KR-12 (Skradin). The distribution of ^{232}Th mostly follows that of ^{40}K. The distribution of ^{40}K and ^{232}Th indicates that the main input of the terrigenuous material in the Krka River Estuary originates from a very small Gudača River inflowing into the Prokljan Lake downstream the Krka River. The Krka River contains larger quantities of a fresh-water (an average of 55 m^2/sec) than the Gudača River (average <1m^2/sec). However, a number of waterfalls along the Krka River, upstream the town of Skradin, significantly reduce the transport of the suspended material. A constant rise of the ^{137}Cs activities from the station KR-1 to the station Kr-12 indicates this, because ^{137}Cs dissolves in the water and its transportation is unobstructed by the waterfalls.

The distribution of ^{238}U and ^{226}Ra shows the same pattern as ^{40}K and ^{232}Th, but with some exceptions, probably as a result of human activities in the Estuary. Future investigation will focus on these activities.

Since the Krka River Estuary functions as a large "water pump" (a flow of a fresh-water on the surface towards the sea, and an opposite flow of a salt-water in the Estuary), the sediment transport is mostly opposite to the river flow. As a result, the marine sedimentation is still predominant at the location KR-5 (2.3 km from the sea).

The results also indicate different relations of the studied elements on the left (KR-4,8) and the right (KR-5,6,7,9) banks of the Krka River Estuary.

	^{40}K	^{232}Th	^{137}Cs	^{226}Ra	^{238}U	depth
	Bq/kg dry weight					m
KR-1	20,5	3,5	0,3	4,3	6,7	33
KR-2	90,3	5,7	2,4	8,5	13,1	38
KR-3	41,8	4,2	0,7	9,8	14,1	32
KR-4	70,4	4,8	2,1	9,5	10,3	25
KR-5	110,3	8,2	2,6	28,7	25,9	27
KR-6	207,9	10,9	4,3	36,4	35,9	29
KR-7	295,2	17,1	7,9	23,5	25,5	24
KR-8	204,9	11,0	5,6	18,7	14,7	29
KR-9	244,1	12,0	8,1	22,7	21,8	24
KR-10	337,3	17,4	10,4	17,1	25,9	25
KR-11	308,6	15,9	15,4	16,9	29,1	14
KR-12	238,8	10,9	22,5	16,6	16,7	8

References

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