CALCULATED SEDIMENTATION RATE IN THE KRKA RIVER ESTUARY USING VERTICAL DISTRIBUTION OF ^{137}CS

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Abstract
Sedimentation rate in the Krka River estuary was calculated from vertical ^{137} Cs distribution in sediments. Calculated sedimentation rate was 2 mm/a upstream of the Prokljan Lake, 4-5 mm/a at the Guduča River mouth in Prokljan Lake and 3-4 mm/a in other parts of the lake. In the lower part of estuary, sedimentation rate was very small, less than 1 mm with exceptions in deepest parts of estuary in front of city Šibenik where sedimentation rate was approx. 3 mm/a.
Keywords : Adriatic Sea, Estuaries, Radionuclides, Sedimentation.

The Krka River estuary was formed during the Holocene transgression. Located between Skradinski Buk waterfalls (calc-tufa barrier) through the Prokljan Lake to the St. Nikola fortress, the estuary has a total length of 22 km (Fig 1).

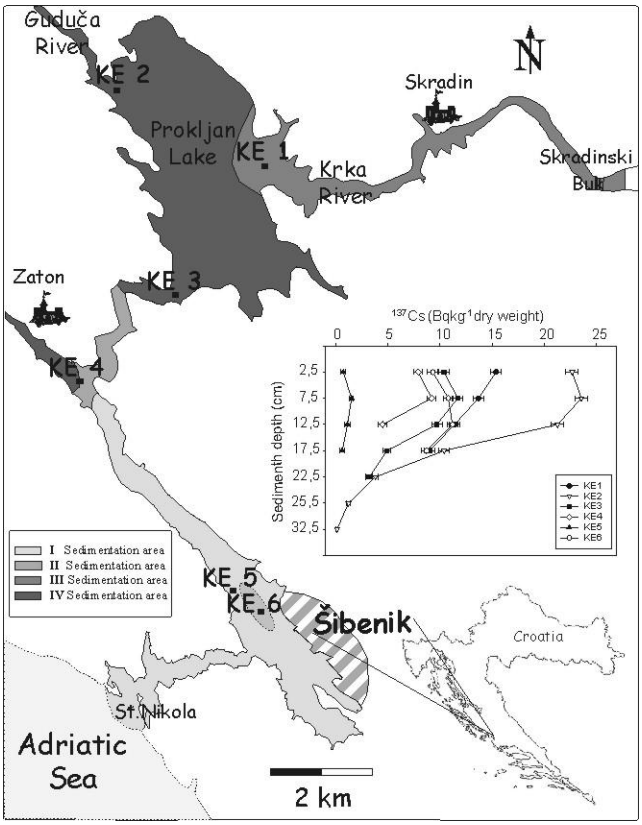

Fig. 1. Krka River estuary, with sampling locations and four different sedimentation areas recognized. Inset: Characteristic ^{137}Cs activities in sediment profiles at investigated locations.

The hydrogeologic drainage area of the Krka River is approximately 2427 km^2. The estuary bottom gradually deepens from 2 m, below the waterfalls, to 42 m in front of Fort St. Nikola. It is typical karstic highly stratified estuary with fresh/brackish surface layer flowing seawards and bottom seawater counter-current moving upward. Input of terrigenuous clastic material into the Krka river estuary is relatively small [1], with main input of the particulate material in the Krka River estuary *via* small Guduča River (Fig 1) inflowing into the Prokljan Lake [1], [2]. The Krka River carries larger quantities of fresh-water (on average 55 m^3/s) than the Guduča River (on average less than 1 m^3/s). However, a number of calc tufa barriers along the Krka River, upstream of the town of Skradin, significantly reduce suspended material transport [1], [2], [3].
The bottom sediment samples were collected by a scuba diver using hand-driven plexyglas corers, at 6 locations in the Krka River Estuary. Prior to the gamma-spectrometry measurements, the sediment samples were 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 an HPGe detector with an 8192 channel analyzer. The system was calibrated using the standards supplied by Amersham International, IAEA-306 and IAEA-314. Sedimentation rate was calculated using the vertical distribution of ^{137}Cs, (Fig 1 inset).

Sedimentation rate in the estuary was found to be very low (0,27 mm/a) based on ^{14}C measurements [1]. First attempts using ^{137}Cs distribution indicated sedimentation rate higher than 2 mm/a ([4]). According the prevailing origin of accumulated material and sedimentation rates, four main sedimentation areas in the Krka River Estuary were recognized [5]. Anthropogenic radionuclides may be released in the environment owing to nuclear explosions, testing of nuclear weapons and discharge of effluents from nuclear facilities. Anthropogenic radionuclide ^{137}Cs with half life of 30,18 a first time entered in the environment as a product of atomic explosions in 1945. Since the Second World War, more than 2400 nuclear weapon experiments have been conducted worldwide [6] and as a result ^{137}Cs spread around the world and become good sediment marker.
In the III sedimentation area where most of the deposited material is carried by the Krka River, calculated sedimentation rate was 2 mm/a, while in the Prokljan Lake where recent sediment consists mainly of particles of terrigenous flysch transported by the Guduča River (IV sedimentation area) was 3-4 mm/a. The highest sedimentation rate was measured at the Guduča River mouth (4-5 mm/a). In the II sedimentation area deposited material is mixture of particles from two main sources: marine carbonates and terrigenous flysch, and the sedimentation rate is less than 2 mm. In the I sedimentation area where carbonate marine sedimentation prevails, sedimentation rate is probably less than 1 mm/a, with an exceptions in the deepest parts of estuary where sedimentation rate is approximately 3 mm/a. This deepest area is located at the center of the lower part of the estuary and acts as a kind of sediment trap (Fig 1).

References

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