

RESEARCH AND MONITORING OF RADIATION AND ECOLOGICAL SITUATION IN SYRDARYA RIVER BASIN AT THE TERRITORY OF THE REPUBLIC OF KAZAKHSTAN

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Introduction

The Syrdarya River is the main life supporting fresh water artery of the South Kazakhstan. Alarming epidemiological situation in this area: almost all medical indicators of the health state of the inhabitants, including children, are much lower than averages for the republic.

One of the main reasons of a high level of sickness in the South Kazakhstan is critical condition of ecological and radio-ecological situation in Syrdarya river basin [1-4]. One of the mechanism leading to this is intensive agricultural activity with use of mineral (phosphor, potassium, nitric) fertilizers. The most important and least studied peculiarity for this region is the presence of considerable reserves (more than 15% of the world reserves) of natural uranium (Karatau ridge and its spurs) and intensive industrial activity on its mining and processing.

Many of these reserves have deposits of carbonaceous- siliceous schist characterized by very high "hurricane" contents of rare and scattered elements. Such dangerous elements as V, Cr, Co, As, Se, Hg, Th and U are easily leached from these rocks by startle water and migrate in large quantities to the main water artery polluting it with radionuclides, heavy metals and toxic elements. Industrial activity connected with uranium mining (especially using the method of underground leaching) favors this process [2, 3]. It is necessary to note that these circumstances about the basins of main water arteries – Syrdarya and Amudarya - relate to both the South Kazakhstan and other countries of the Central Asia. It became the base for investigation of level and character of contamination of these river basins on the territories of four countries of the Central Asia: Kazakhstan, Uzbekistan, Tajikistan and Kyrgyzstan.

In this connection beginning from November 2000. International Project "Navruz" is carried out. Its main goal is radio-ecological investigation and monitoring of these rivers and their inflows. The project is planned for 2 years, to be finished in September 2002, with the collaboration of Cooperative Monitoring Center at Sandia National Laboratories, USA.

Experiment

According to the monitoring program 15 monitoring points in each country were determined. During these years selection of environmental samples (water, soil, bottom sediment and vegetation) for further laboratory investigations were carried out (two times a year, in spring and autumn) only at these points [5, 6, 7]. Since 2003 15 additional research and control points (constantly changing) were applied to the work program (Fig.1). Samples from those locations were analyzed for sources of radionuclide and chemical contamination of aquatic environment of these rivers.

At the expeditions the following works are carried out, besides selection and preliminary preparation of a environmental samples: areal photograph, determination of control points' geographical coordinates (satellite and topo-adjuster GARMIN E-MAP), determination of general physical-and-chemical parameters of water (the Hydrolab device).

Laboratory investigations are carried out by methods of instrumental and γ -spectrum radionuclide analysis as well as instrumental element analysis (neutron-activation and roentgen-fluorescent). Isotopes of ^{238}U , ^{235}U , ^{232}Th radioactive family as well as Cr, As, Se, Zn, REE toxic elements and others have been investigated. The obtained results of analytic investigations revealed a number of peculiarities on contamination of basins of the Syrdarya river by radionuclides and toxic elements.



Fig 1. Locations of monitoring and research points at the territory of Symkent region in the Syrdarya river basin

Results and Discussion

A high level of contamination by natural radionuclides (^{238}U , ^{235}U , ^{232}Th family) is typical for Syrdarya river basin at the territory of Kazakhstan. Fig. 2 presents the distribution of radionuclide concentration of ^{234}Th dissolved in water in autumn along the Badam, Arys and Syrdarya rivers.

^{234}Th (daughter product of ^{238}U) in river water is mostly found in dissolved form. Suspensions comprise up to 10% of its total in river water. Radionuclide concentration of dissolved ^{234}Th along the Syrdarya river is 120-180 mBq/l, 140 ± 19 mBq/l on the average. The concentrations of higher than average correspond to KZR-21 point (possibly due to the influence of the Zarechnoe deposit), near the KZ-08, KZ-09, KZ-10 points (possibly due to the influence of families of uranium deposits near the Shieli town), and KZ-14 point (possibly due to the influence of the Karaozek channel).

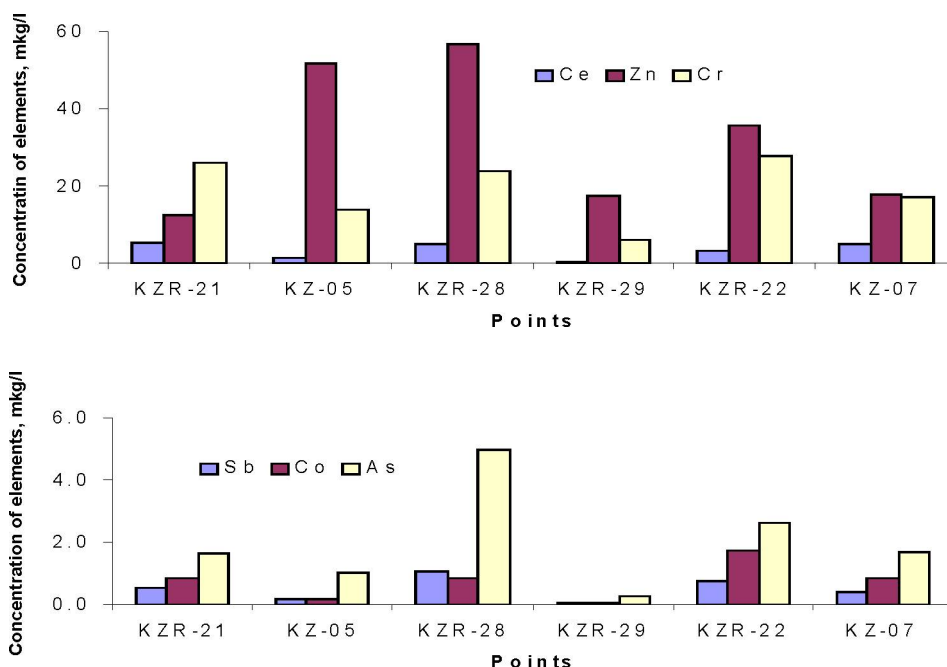


Fig 2. Distribution of radionuclide concentration of ^{234}Th dissolved in water along the Badam, Arys and Syrdarya rivers

In comparison with Syrdarya in water, ^{234}Th concentration in Arys and Badam rivers is low. Its average value is 57 ± 19 mBq/l.

In water of the Badam river, down Shymkent city, there were revealed a high concentration of Zn and As (Fig. 3), that is undoubtedly connected to the influence of the manufacturing enterprises in this city.

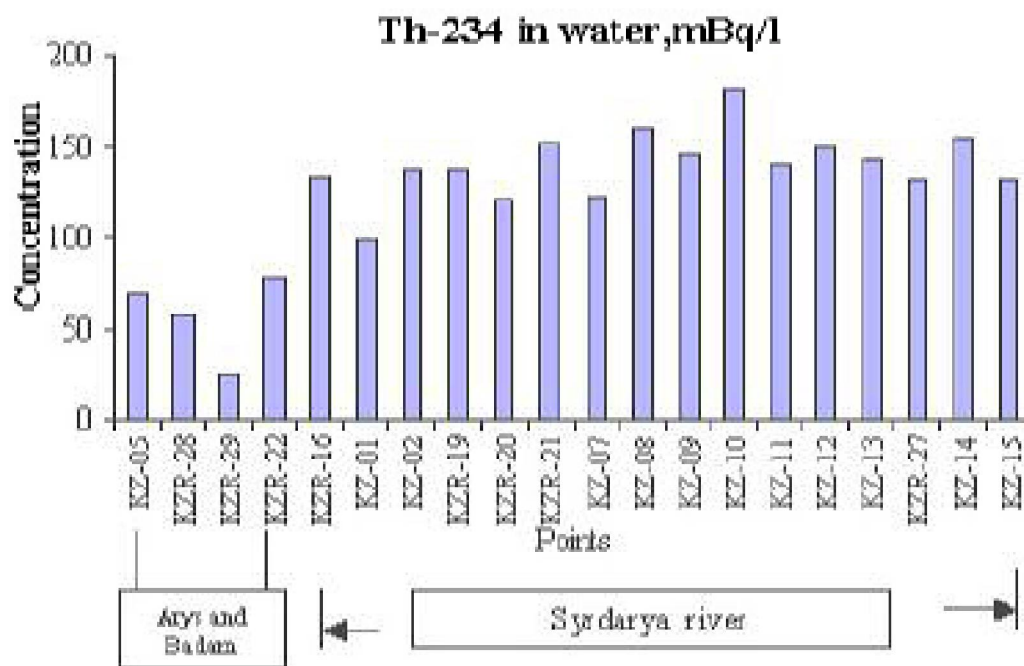


Fig 3. Distribution of microelement concentrations as dissolved and undissolved Badam, Arys and Syrdarya rivers.

A high level of bottom contamination of the Shardaryinsk reservoir has been revealed. Fig. 4. presents distribution of Sb, As, Co, Zn and Ce (REE) concentrations in bottom sediments along the Syrdarya river. As, Co, Zn and REE concentrations in bottom sediments are higher up to the Sharda reservoir (KZR-16 and KZ-01 points).

One may suppose that this reservoir is a peculiar settling, accumulating in it a considerable part of toxic elements carried by water from Uzbekistan and the inflows of the Keles and Kurkeles rivers.

Farther, over the Sharda reservoir (KZ-02, KZR-19, and KZR-20 points), concentrations of these elements are essentially low.

Probably, water is cleaned precipitating in the reservoir. At the KZ-07 point a high concentration of these elements is again observed. Possibly, it is connected with influence of "Zarechnoe" uranium deposit.

At the KZ-12 point As, Co, Zn and REE concentrations are essentially high; it may be due to the influence of the industrial city Kyzylorda. Sb concentration does not change along the river Syrdarya.

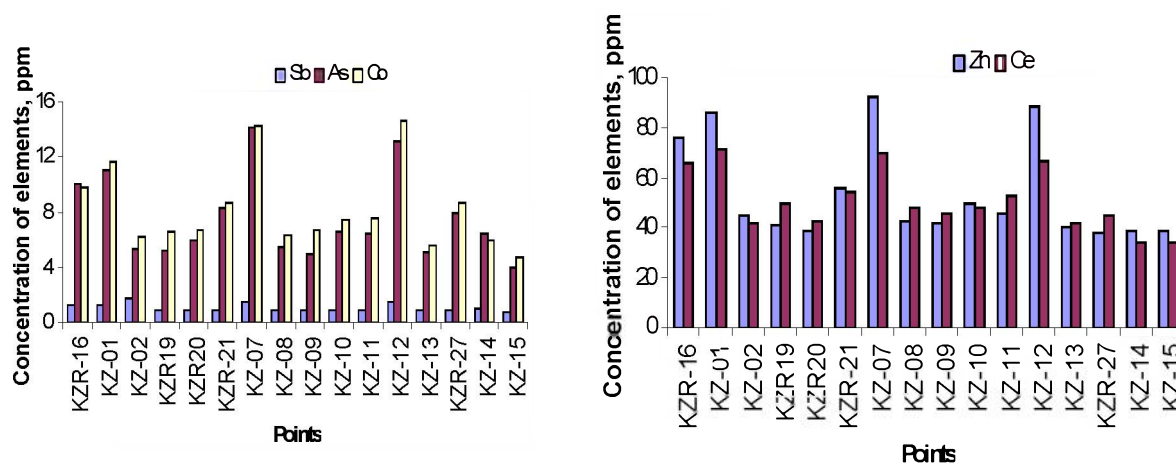


Fig 4. Distribution of microelements in bottom sediments along the Syrdarya river

The results presented will serve as the basis for modeling aquatic environment and elaboration of works on removing or limiting the mechanisms of radionuclide and chemical contamination of the most important fresh water artery in the Central Asia, the Syrdarya river.

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