^{131}I Dose Reconstruction in the Former Soviet-Union (FSU) by Measurement of ^{129}I

H. Reithmeier, V. Lazarev, W. Rühm [a], A. Blinov [b], T. Huber, F. Kubo, and E. Nolte
[a] Strahlenbiologisches Institut LMU München
[b] Department of Cosmic Research, Physical-Technical University of St. Petersburg

Besides the nuclear bomb tests, the major releases of fission products in the Former Soviet-Union (FSU) originate in the plutonium production facilities Chelyabinsk, Tomsk and Krasnoyarsk (all Russia). Especially during the early years of operation, relative large routine releases occurred in these facilities [1,4]. There are measurements of ^{90}Sr and ^{137}Cs depositions, but almost nothing is known about the ^{131}I deposition.

The long-lived fission product ^{129}I ($T_{1/2}$= 15.7 Myr) can be used to reconstruct the ^{131}I deposition in the region of the FSU. For that purpose it is important to know the background level of ^{129}I resulting from other sources.

This background was determined by measuring ^{129}I concentrations in lakes Baikal (Russia), Balkhash (Kazakhstan) and Issyk-Kul (Kyrgyzstan), all far away from the russian sources of radio-iodines.

Experimental method

Because of the very low iodine concentrations in the lake water samples, ^{127}I carrier was added. The iodine was extracted from the water samples and purified by using a carbon tetrachlorid method [5] and finally precipitated as AgI.

The ^{129}I/^{127}I ratios were measured by AMS. For that, a time-of-flight (TOF) system was installed, consisting of a micro-channel plate detector and a surface barrier counter (SBC). A scheme of the TOF system is shown in Fig. 1. The sensitivity of the system is at a ratio of 10^{-14}.

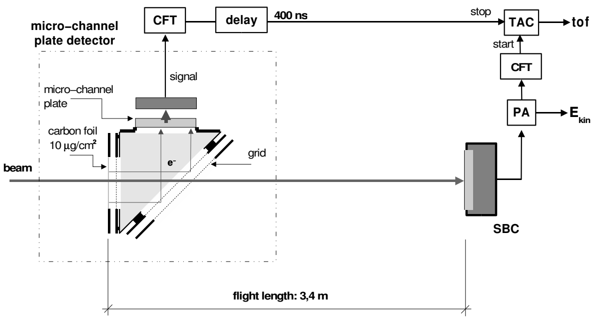

Fig. 1: Schematic layout of the TOF system.

The use of ^{127}I carrier made it possible, to determine the ^{129}I concentrations in the lake water samples without measuring the content of stable iodine. The measured ^{129}I/^{127}I ratios and the resulting ^{129}I concentrations are listed in Tab. 1.

Results

The ^{129}I concentrations in the european lakes showed, that only the direct input of ^{129}I on the lake area with rain reaches the lake reservoir. Hence we could confirm, that soil is a useful reservoir of the deposited ^{129}I for a ^{131}I dose reconstruction [2,3].

	^{129}I/^{127}I [10^{-14}]	^{129}I conc. [10^7 at/l]
Ammersee	100 ±30	3.9 ±1.2
Lago Maggiore	62 ±40	1.9 ±1.2
Lago di Garda	220 ±40	6.8 ±1.2
Baikal	56 ±10	1.0 ±0.2
Balkhash	660 ±440	21 ±14
Issyk-kul	94 ±33	3.1 ±1.1

Table 1: The measured ^{129}I/^{127}I ratios and the resulting ^{129}I concentrations in the lake water samples.

Herewith it is possible to determine the ^{129}I fluences in the region of lake Baikal ($7.4 \pm 1.3 \times 10^{12}$ at/m^2) and lake Issyk-kul ($8.5 \pm 3.1 \times 10^{12}$ at/m^2). The order of magnitude of these fluences can be explained by the gaseous ^{129}I emissions from the european reprocessing facilities in Sellafield (U.K.) and La Hague (France).

Recently a dam was constructed at the main influx of the lake Balkhash, which disturbed the exchange conditions of the two parts of the lake. A ^{129}I deposition flux in this region cannot be given yet.

Outlook

Soil samples in the region of the Chelyabinsk facility will be taken and their ^{129}I contents will be analyzed in layers. Thus the ^{129}I deposition fluxes in this region can be determined. A Chernobyl soil sample will give the migration velocity of the ^{129}I in the soil.

References

[1] A.V. Akleyev Sci. Total Environ. **142** (1994) 1-8
[2] V. Mironov *et al.*, J. Environ. Rad. **59** (2002) 293-307
[3] T. Straume *et al.*, Health Phys. **71** (1996) 733-740
[4] UNSCEAR Report 2000, United Nations, 2000
[5] Z. Zhou, Ph.D. thesis, Université Paris XI Orsay, 1995