Measurements of ^{129}I in Lake Water Samples ◇

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The plutonium production facility Mayak, situated closed to the city of Chelyabinsk (Russia), has been the first facility of this type in the Former Soviet-Union (FSU). It is known that large amounts of fission products were released there especially in the early years of operation [1,3]. The Techa River Dosimetry System-2000 [2] is an attempt to reconstruct the internal and external doses for 30,000 people who lived in the valley of the Techa River, which was contaminated in 1949-56 by these discharges.

However compared to the Life Span Study (LSS) on survivers of the atomic bombs in Hiroshima and Nagasaki, the epidemiological studies in the Techa River region show a discrepancy in the radiological effect.

Additional exposure to releases of short-lived radioisotopes like ^{131}I could explain this discrepancy by a higher internal radiation dose of the inhabitants of the Techa River region.

The long-lived fission product ^{129}I ($T_{1/2}$= 15.7 Myr) can be used to reconstruct the ^{131}I deposition in this region. 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 lake water samples far away from the russian sources of radio-iodines.

Experimental method

The iodine extraction out of the lake water samples and the AMS measurement was formerly described in [4]. Because iodine carrier was used, the AMS measurement could not give information on the ^{129}I/^{127}I ratios in the water samples. To get this additional information, the stable iodine concentration was measured in an aliquot taken from the lake water samples before adding the ^{127}I carrier.

Therefor the setup for a photometric measurement using the reaction: As(III) + 2Ce(IV) → As(V) + 2Ce(III), which is catalysed by the presence of iodid [5], was installed. The measured ^{129}I concentrations and ^{129}I/^{127}I ratios are listed in Tab. 1.

Transport model

To reconstruct the global atmospheric ^{129}I spreading, a transport model is used. It is composed of 5 altitudinal layers and one archiv, which are devided in 18 latitudinal and 12 longitudinal sectors each (Fig.1).

The considered ^{129}I input consists of the airborne and liquid ^{129}I releases in the european reprocessing plants in Sellafield (U.K.) and La Hague (France). Exchange processes between the boxes are diffusion in horizontal direction, sedimentation and wash out in vertical direction and transport by the mean eastern winds in each latitudinal belt.

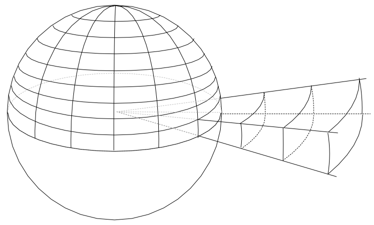

Fig. 1: Schema of the boxes used in the transport model.

The transport model yields averaged ^{129}I deposition fluxes and deposition fluencies. The quotient of measured and calculated ^{129}I depositions are listed in Tab. 1.

	^{129}I-conc. [10^6 at]/l	^{129}I/^{127}I [-]	$\frac{meas.}{calc.}$ [-]
European lakes			
Bodensee	94 ±13	$6,6 \cdot 10^{-8}$	0,5
Starnberger See	421 ±53	$2,3 \cdot 10^{-8}$	0,9
Comer See	79 ±7	$2,1 \cdot 10^{-8}$	0,8
lakes in FSU			
Ladoga	134 ±5	$1,9 \cdot 10^{-8}$	1,4
Onega	137 ±10	$1,6 \cdot 10^{-8}$	1,1
Khubsugul	19 ±1	$1,3 \cdot 10^{-8}$	0,6
Uvs Nur	72 ±9	$2,0 \cdot 10^{-9}$	0,2
African lakes			
Mweru	2,5 ±0,5	$2,7 \cdot 10^{-10}$	0,7
Victoria	≤ 1	$\leq 2 \cdot 10^{-11}$	0,3

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

Results

The ^{129}I deposition fluxes and deposition fluencies in the region of the FSU are in good agreement with the previously measured values [4] and the results of the transport model. Their order of magnitude can still be explained by the gaseous ^{129}I emissions from the european reprocessing facilities in Sellafield (U.K.) and La Hague (France).

Outlook

Soil and wood samples of the Chelyabinsk region will be taken and their ^{129}I contents will be analyzed at the Maier-Leibnitz-Laboratorium by AMS. Therefor a setup for ashing solid samples will be installed. Soil samples will give the ^{129}I deposition fluencies and tree rings the time resoluted ^{129}I deposition fluxes.

References

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◇ We thank D. Wabner (AAE, TU München) for allocating a photometer for the ^{127}I measurements and Th. Görlach for the support of the measurements.