Traces of Radioactive ^{131}I in Rain Water and Milk Samples in Romania

Romul Margineanu,[*a] **Bogdan Mitrica,**[*a] **Ana Apostu,**[*a] **and Claudia Gomoiu**[*a]

Abstract Measurements of ^{131}I ($T_{1/2}$ = 8.04 days) have been performed in IFIN-HH's underground laboratory situated in Unirea salt mine from Slanic-Prahova, Romania. The rain water samples were collected in March 27th from Brasov and in March 27th, 29th and April 2nd from Slanic-Prahova. Also sheep milk was collected in Slanic area and subsequently measured. The samples were measured in the IFIN-HH's underground laboratory, in ultra-low radiation background, using a high resolution gamma-ray spectrometer equipped with a GeHP detector having a FWHM = 1.80 keV at 1332.48 keV at the second ^{60}Co gamma-ray and a relative efficiency of 22.8 %. The results show a specific activity of ^{131}I from 0.15 to 0.75 Bq/dm^3 for rains. In the sheep milk from Slanic area the specific activity of ^{131}I was about 5.2 Bq/dm^3.

1 Introduction

The Fukushima accident started on March 11th, 2011 causes the release of significant amounts of ^{131}I, ^{171}Cs and other radioactive isotopes in the environment. The atmospheric currents spread the radioactive contamination all over northern hemisphere. According with meteorological information the radioactive cloud has reached the Romanian territory beginning with March 25-26, [1, 2]. The meteorological conditions over Romania were characterised by small rains. Six sample, five of rain water and one of sheep milk, were taken for analyse.

Fig. 1 Photo from Unirea salt mine left, photo of the underground laboratory - right

The samples were measured in the institute's underground laboratory from Slanic-Prahova, see Fig. 1. The laboratory was constructed and putted in operation in 2006, [3]. The characteristics of the galleries of the Unirea salt mine are:

- depth: 208 m bellow ground level
- temperature: 12.0 -13.0 °C
- humidity: 65-70 %
- excavated volume: 2.9 million m^3
- floor area: 70000 m^2
- average high: 52-57 m
- distance between walls: 32-36 m
- existing infrastructure: electricity, elevator, phone, Internet, GSM networks.
- equivalent depth from cosmic ray muon measurements: 610 mwe (meter water equivalent), [4].

2 Measurements and results

The measurements were performed with a CANBERRA ultra-low GeHP system, equipped with a detector having a relative efficiency of 22.8 %, assisted by an INSPECTOR 2000 multichannel analyser and GENIE 2000 software code. The detector is housed in a 10 cm Lead and 2 cm Copper shield, which assures a reduction of the background of 1600 times with respect to the spectrum collected outdoor at surface, see Fig. 2.

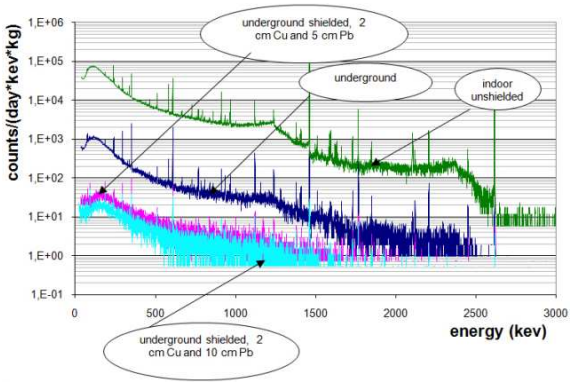

Fig. 2 Four experimental gamma spectra of the background measured indoor at surface and in underground unshielded, shielded with 5 cm Lead and 2 cm Copper and shielded with 10 cm Lead and 2 cm Copper [5]

The efficiency of the measurement system was determined with IAEA-444 reference material which is a soil from China containing a cocktail of ^{109}Cd, ^{60}Co, ^{137}Cs, ^{54}Mn and ^{65}Zn

[a] *Horia Hulubei National Institute of Physics and Nuclear Engineering - IFIN HH, Reactorului 30, P.O.BOX MG-6, 077125, Magurele, Ifov, Romania, romulus@ifin.nipne.ro, mitrica@ifin.nipne.ro, anapostu@ifin.nipne.ro, cgomoiu@ifin.nipne.ro*

radionuclides. The energy dependence of efficiency is represented in log-log graph in Fig. 3.

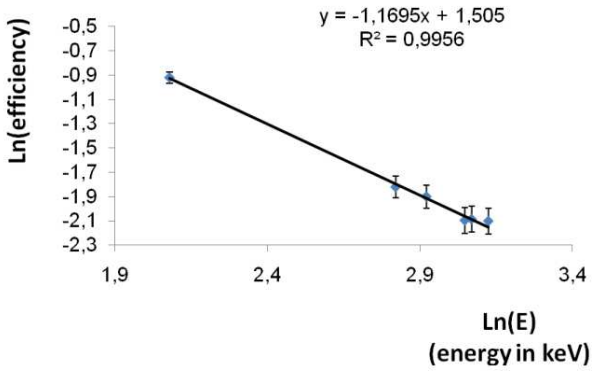

Fig. 3 Efficiency versus energy for the spectrometric system equipped with an ultra-low GeHP detector with 22.8 % relative efficiency

Samples of rain water were collected beginning with March 27 and were measured in cylindrical plastic box of 75 mm diameter and 35 mm high. The volume of measured samples was 80 cm3. The ^{131}I line at 364.48 keV has been seen in all collected spectra. This aspect is illustrated for rain water sample collected in the morning of March 29th in Slanic in Fig. 4. The specific activities of ^{131}I in the rain water samples are presented in Tab. 1.

Table 1 Specific activity of ^{131}I in rain water samples

Sample	Location	Sampling date	Bq/dm^3
1	Brasov	March 27, 2011	0.41 ± 0.04
2	Slanic	March 27, 2011 - morning	0.52 ± 0.05
3	Slanic	March 27, 2011 - evening	0.15 ± 0.02
4	Slanic	March 29, 2011	0.75 ± 0.06
5	Slanic	April 2, 2011	0.69 ± 0.06

In April 5th a sheep milk sample has been collected and subsequently measured in the same way as rain water samples. The specific activity of ^{131}I measured in sheep milk is 5.2 ± 0.5 Bq/dm^3.

3 Comments

From the results, one can observe the presence of ^{131}I in very small amounts in the precipitation and milk recorded beginning with 27 March 2011 in Brasov and Slanic Prahova, Romania. The specific activity in rain water of ^{131}I varies from 0,15 Bq/m^2 to 0,75 Bq/m^2.

For the moment, no other data have been available for analyses, but even so we can suppose that the ^{131}I originates from

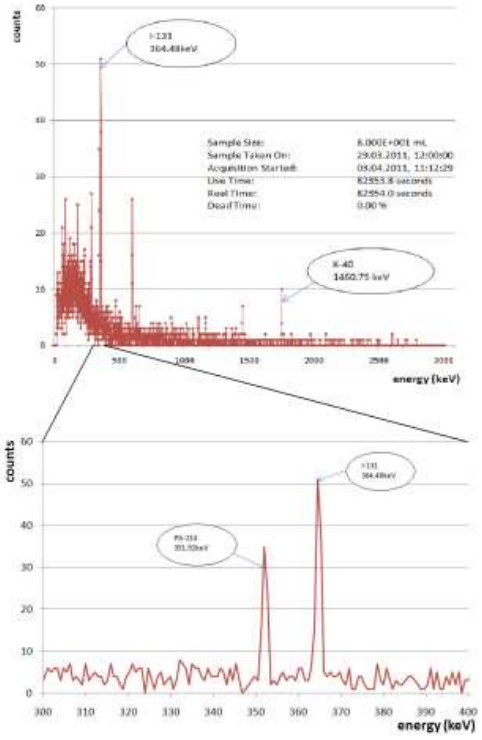

Fig. 4 Gamma ray spectrum of ^{131}I in the rain water from Slanic collected in the morning of 29 March 2011 up, a detail of the same spectrum -down

Fukushima nuclear accident. For this reason, the environmental radioactivity, especially in rain water and milk, is monitored continuously in order to assess the level of radioactive deposition.

The measured activities are far bellow any intervention limits. For instance in Japan the limit for drinking water was set at 300 Bq/dm^3 for adults and children and 100 Bq/dm^3 for infants [6]. The values measured by us are 2 to 3 order or magnitude lower than these limits. In sheep milk the ^{131}I concentration is more than an order of magnitude lower than the limits.

The presence of ^{131}I over Romania demonstrates that the consequences of a nuclear accident could be put in to evidence even at more than 10,000 km away which also demonstrates that at this moment the radioactive plume originating in Fukushima is spread practically all over the Northern Hemisphere.

References

1 http://www.bucharestherald.ro/dailyevents/41-dailyevents/20825-radioactive-cloud-over-franc
2 http://stirileprotv.ro/stiri/social/norul-radioactiv-de-la-fukushima-a-ajuns-in-romania.html
3 R. Margineanu et al., Appl.Rad.Isot. 67 (2009) 759-761

4 B. Mitrica et al., AIP Conference Proceedings, 1304 (2010) 331-335
5 R. Margineanu et al., Appl.Rad.Isot. 66 (2008) 1501-1506
6 http://www.riken.jp/engn/r-world/topics/110314/data/0324_water.pdf