



Natural and Artificial radionuclides in moss samples from the region of Northern Greece

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Abstract

Naturally occurring radionuclides ⁷Be and ²¹⁰Pb together with the artificial ¹³⁷Cs are a useful tool in studying the environmental processes.

Terrestrial mosses can be used for investigation and monitoring of airborne radionuclide depositions. Due to the lack of an elaborate rooting system, they obtain most of their nutrients directly from precipitation and dry deposition. That makes them an ideal sampling medium for metals and airborne radionuclides deposited from the atmosphere. [1,2]

The aim of this study is to measure activities of the radionuclides ¹³⁷Cs, ⁷Be, ²¹⁰Pb and ⁴⁰K in mosses and investigate their possible variabilities over different places in Northern Greece.

Sampling and Analysis

Ninety five (95) samples of Hypnum Cupressiforme were collected in the region of Northern Greece (Fig. 1). All samples were collected in a short time interval during the end of summer 2016. After sampling, mosses were dried at 105°C for 2 hours and all the impurities were removed manually. After the preparation, mosses were put in two cylindrical plastic containers, diameter 67 mm and height 31 mm. They were measured in a low-background HPGe detector with relative efficiency 36%.

Results and Discussion

The range of activity concentrations of ⁷Be, ¹³⁷Cs, ²¹⁰Pb and ⁴⁰K in moss samples are shown in Table 1. Differences have been observed in the activity concentrations between the mosses collected from ground surface, rocks, branches and roots (Fig. 2). ⁷Be and ²¹⁰Pb activity concentrations are higher in moss samples taken from the ground surface and rocks than those collected near roots. ¹³⁷Cs concentrations are higher in mosses collected near roots and rocks than those collected near the ground surface. ⁴⁰K concentrations are higher in mosses collected from branches and near roots than those collected from rocks.

No variances are observed in ⁷Be concentrations due to different altitudes. The activity of ²¹⁰Pb in mosses can vary from region to region due to the different soil structure. The majority of ²¹⁰Pb in mosses has arrived from aerosol deposition (e.g. dust that contains ²³⁸U daughters).

No correlation has been found between the concentrations of ⁷Be, ²¹⁰Pb and ⁴⁰K. The absence of correlation between ⁷Be and ⁴⁰K, points out that ⁴⁰K was transferred to mosses due to the re-suspension and the decayed plant matter covering them.

The coincidence of heavy rainfall events during May 1986 with the passage of air masses from the Chernobyl area to Northern Greece had as a result high concentrations of ¹³⁷Cs at the ground level in Northern Greece.

The regions in which the activity concentrations of ¹³⁷Cs in moss samples are high, are in a good correlation with the regions where the activity concentrations of ¹³⁷Cs in soil samples are high and were also characterized as highly contaminated right after the Chernobyl accident (Fig. 3). The majority of ¹³⁷Cs in mosses has arrived through aerosol deposition (re-suspension).

Table 1. Radionuclides activity concentrations in Bq kg⁻¹ in moss samples

Radionuclide	Range (mean value) Bq kg ⁻¹
⁷ Be	69-1280 (388)
¹³⁷ Cs	0-425 (35)
²¹⁰ Pb	147-1920 (817)
⁴⁰ K	120-750 (269)

References

- [1] Krmar, M., Wattanavatee, K., Radnović, D., Slivka, J., Bhongsuwan, T., Frontasyeva, M.V., Pavlov, S.S., 2013. Airborne radionuclides in mosses collected at different latitudes. *Journal of Environmental Radioactivity* **117**, 45-48.
- [2] Krmar, M., Radnović, D., Mihailović, D.T., Lalić, B., Slivka, J., Bikit, I., 2009. Temporal variations of ⁷Be, ²¹⁰Pb and ¹³⁷Cs in moss samples over 14 month period. *Applied Radiation and Isotopes* **67**, 1139-1147.

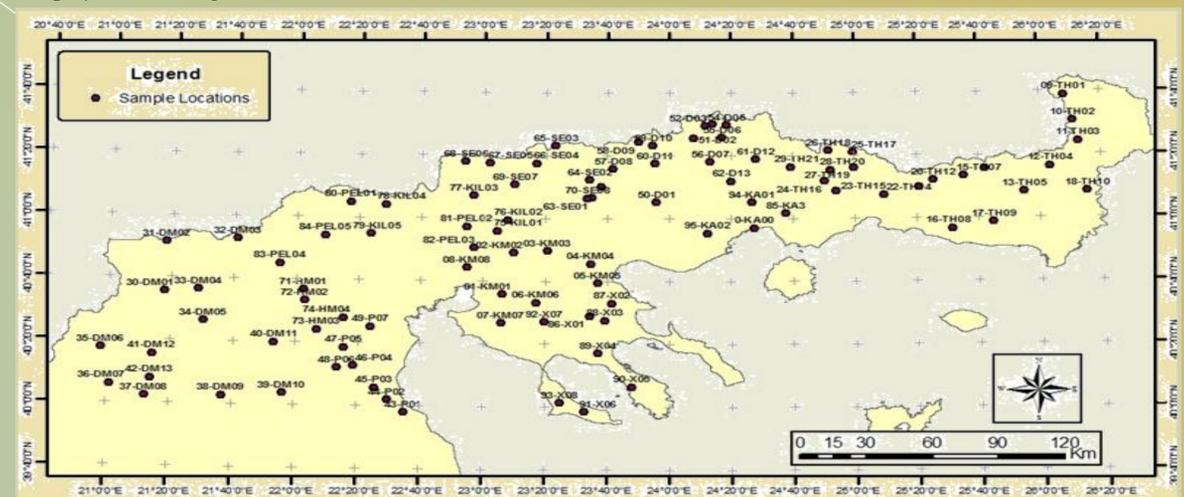


Figure 1. Area of sampling sites.

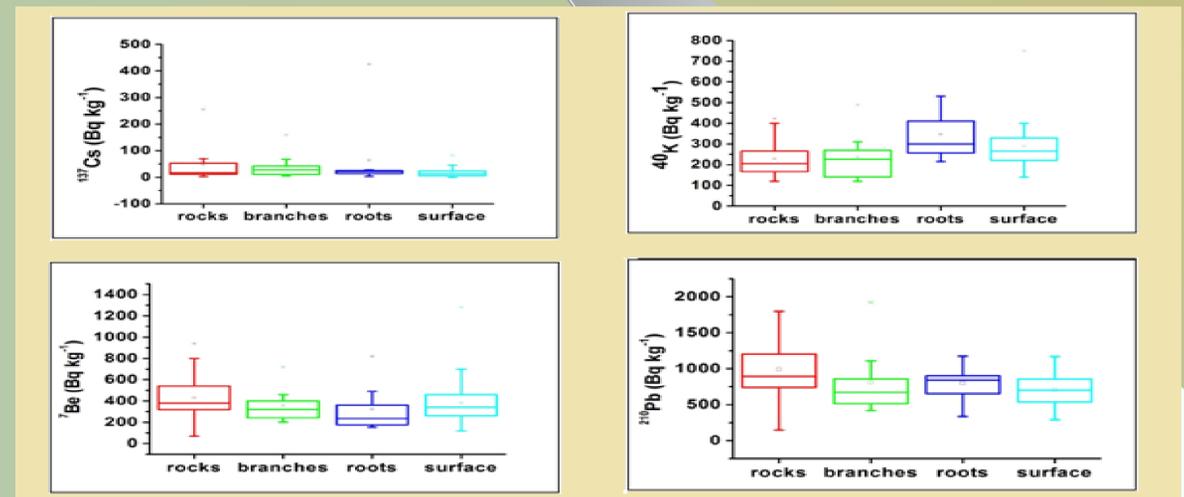


Figure 2. Differences in the radionuclide's activity concentrations in moss samples collected from different surface types (on the surface, near roots, on rocks and on branches).

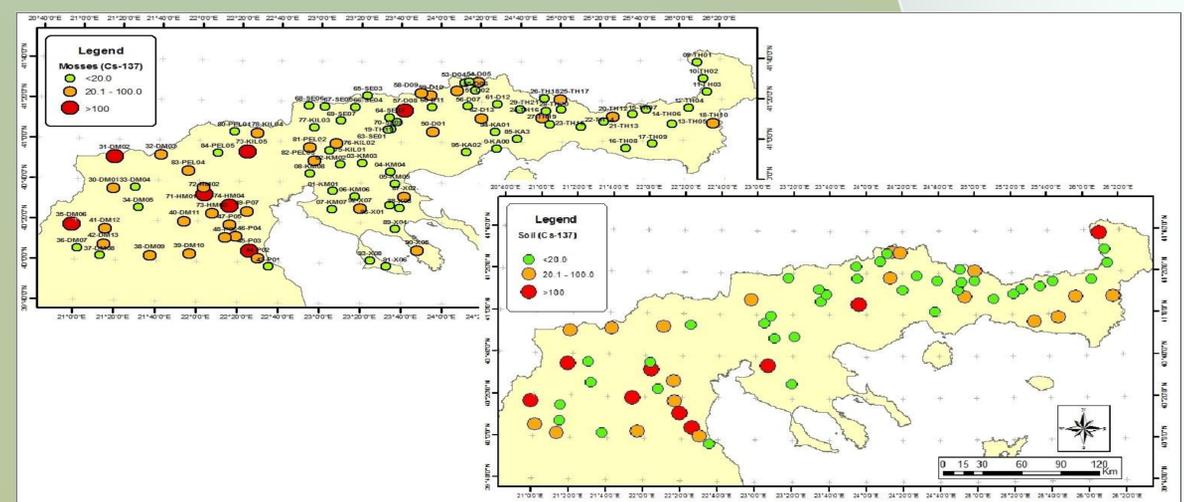


Figure 3. The activity concentrations of ¹³⁷Cs in moss samples and in soil samples collected from the same regions. There is a good correlation between the concentrations of ¹³⁷Cs in soil and in moss samples.