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**CORRELATIONS BETWEEN METEOROLOGICAL
PARAMETERS AND ^7Be SPECIFIC ACTIVITY
MEASURED AT GROUND LEVEL AIR IN BELGRADE,
SERBIA**

A. Samolov^{a,*}, S. Dragović^b and M. Daković^c

^a*Military Technical Institute, Belgrade, Serbia*

^b*Vinča Institute of Nuclear Sciences, Belgrade, Serbia*

^c*Faculty of Physical Chemistry, University of Belgrade, Serbia*

ABSTRACT

Standard gamma-ray spectrometric analysis of air samples was performed in Belgrade (Serbia) during 2009-2011 and values of ^7Be specific activities were obtained. Meteorological data from the same period were collected, as well, and correlations between them were calculated. Values of correlation coefficient are low, but in accordance with the literature.

INTRODUCTION

The radionuclide ^7Be ($t_{1/2}=53.3$ d) forms in the stratosphere and upper atmosphere in reactions of spallation on nuclei of oxygen and nitrogen by beams of protons and neutrons from cosmic radiation. Almost immediately after creation, atoms of ^7Be are captured by aerosol particles and follow their paths through the air masses. Aerosol particles contain most of the air pollutant particles, so they can be used as a tracer for circulation pathways in the atmosphere, as well as for deposition kinetics of atmospheric macro and micro particles.

It is well known that the production of ^7Be depends on the intensity of cosmic radiation reaching the upper atmosphere. Seasonal variation of ^7Be in the lower layers of the atmosphere depends on the vertical and horizontal flow of air masses [1]. Continuous daily monitoring of ^7Be concentration in surface air can provide information on solar activity by using a simple gamma-spectrometric method [2], since the ^7Be concentration in the air is independent of human activities, i.e. nuclear tests and technological development. In this study, we present results of ^7Be specific activities measurements in near-ground air by using standard gamma-spectrometric procedure, and correlations between ^7Be specific activity and meteorological parameters.

EXPERIMENTAL

Air sampling was conducted in the period from March 2009 to December 2011 at Kumodraz, on the outskirts of Belgrade, Serbia. Standard sampling procedure was performed. Samples were collected weekly, with a total of 101 samples. Digital samplers were capable of measuring temperature, pressure and relative humidity. Values for wind speed, insolation (sunny hours per day), global Sun warming and precipitation were provided by the Republic Hydrometeorological Service of Serbia.

The measurements were performed on a gamma-ray spectrometric system AMETEK-AMT (ORTEC, USA) with a coaxial high-purity germanium (HPGe) detector with relative efficiency of 59.2% measured on the line 1.33 MeV ^{60}Co . Resolution of the device was 1.78 keV on the line 1.33 MeV ^{60}Co . Gamma-ray spectrometric analyses were conducted on the device calibrated to the filter geometry. ^7Be specific activity of air samples was evaluated from its line at 477.6 keV, for 250 000 s by using the Gamma Vision 32 software package [3].

RESULTS

The ^7Be average monthly activities for the period from March 2009 to December 2011 are presented in Figure 1. Table 1 presents descriptive statistics on experimental data, while Table 2 presents correlation coefficients of meteorological parameters of air and ^7Be specific activities.

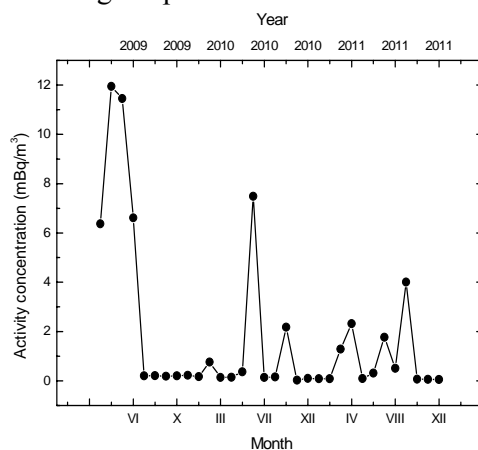


Figure 1. The ^7Be average monthly activity for the period from March 2009 to December 2011 measured at Kumodraz, Belgrade

Table 1. Descriptive statistics of experimental data for the period from March 2009 to December 2011

Experimental data	mean	standard deviation	median	mode	min	max	skewness	kurtosis
specific activity (mBq/m ³)	1.8	3.4	0.2	/	0.02	14.8	2.4	4.7
maximum temperature (°C)	21.9	9.2	23.1	28.3	-0.6	36.1	-0.7	-0.1
precipitation (mm)	11.1	12.9	6.9	0.0	0.0	58.2	1.5	2.1
insolation (h)	38.5	21.4	38.4	63.2	0.0	88.3	0.1	-1.0
global Sun warming (W/cm ²)	1268.3	697.4	1288.3	1667.3	1	2615.8	0.05	-1.0
wind speed (m/s)	2.5	0.7	2.3	2.2	1.3	4.9	0.9	1.3
maximum pressure (mm Hg)	711.4	18.1	707.9	707.9	683.8	765.1	1.1	0.7
relative humidity (%)	83.9	15.0	89.0	89.0	25.0	100.0	-2.0	3.9

Table 2. Correlation coefficients of meteorological parameters of air and ⁷Be specific activities

Meteorological parameter	Correlation coefficient
wind speed (m/s)	-0.24
insolation (h)	0.20
precipitation (mm)	-0.17
maximum pressure (mm Hg)	-0.15
maximum temperature (°C)	0.16
relative humidity (%)	-0.04
global Sun warming (W/cm ²)	0.23

DISCUSSION

The ⁷Be specific activity was in the range from 0.03 mBq/m³ to 11.95 mBq/m³ (see Fig. 1). This is in agreement with the results for the Belgrade area obtained by other authors, whose values ranged from 0.6 mBq/m³ to 7 mBq/m³ [4] and from 1.9 mBq/m³ to 10.2 mBq/m³ [5]. It is characteristic that the maximum values are observed in summer and minimum in winter, which was observed in all studies. Todorovic et. al. (2010) reported that the average ⁷Be activities for five years, observed in the Vinca Institute (outskirts) and in downtown Belgrade, were 2.54 mBq/m³ and 2.73 mBq/m³ respectively. Activity values found in our study, obtained for the period of less than three years, and at one location (outskirts) were 1.8 mBq/m³.

Positive correlation was observed between air temperature and specific activity which was consistent with the results of other authors [4, 6, 7]. Considering the fact that insolation, global Sun warming and air temperature are correlated, a positive sign of the correlation coefficient between these parameters and specific activity seems quite logical. The correlation coefficient between precipitation and specific activities was negative, which can be due to the removal of ^7Be by wet deposition [8]. Negative sign in cases of wind speed and pressure show possible inverse correlation, while relative humidity doesn't seem to have any influence on ^7Be specific activity [6, 7]. Some authors have stated that this might be due to the type of climate or to the height of the sampling location [6]. However, values of all correlation coefficients are rather low. It has been suggested [7] that correlation can be improved if sampling is performed on a daily basis instead of on a weekly basis as done here.

CONCLUSION

The results presented here are in accordance with the literature. Maximum specific activity values in the summer could be explained with vertical air mixing and a transport of cosmogenic radionuclides towards low atmospheric level. Moreover, seasonal variations seem to be more related to temperature and parameters correlated with it, and precipitation, than to other meteorological parameters.

REFERENCE

- [1] D. Todorović, D. Popović, G. Djurić, *Environment International*, 1999, 25(1), 59.
- [2] S. Kikuchi, H. Sakurai, S. Gunji, F. Tokanai, *Journal of Environmental Radioactivity*, 2009, 100, 515.
- [3] *Gamma Vision 32*, Gamma-Ray Spectrum Analysis and MCA Emulation, Version 5.3., ORTEC, Oak Ridge, USA, 2001.
- [4] D. Todorović, D. Popović, J. Nikolić, J. Ajtić, *Radiation Protection Dosimetry*, 2010, 142, 308.
- [5] N. Lazarević, D. Rajić, M. Jevremović, A. Nouri, A. Jamhour, *Scientific Technical Review*, 2009, 3-4, 65.
- [6] M. Raneli, S. Rizzo, E. Tomarchio, IAEA-CN-145/174P (2007).
- [7] E. Krajny, L. Osrodka, M. Wojtylak, B. Michalik, J. Skowronek, *Nukleonika*, 2001, 46, 189.
- [8] S. Kikuchi, H. Sakurai, S. Gunji, F. Tokanai, *J. Environ. Radioact.*, 2009, 100, 515.