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Research Article

The gross alpha and beta radioactivity concentration on the Sivrice (Elazığ) fault zone

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Abstract

Sivrice Fault Zone of the East Anatolia Fault System is seismically active and it often produces earthquakes in various magnitudes (almost between 2.0-4.5 Md). Recently, we have been monitoring the existence of soil radon in different four locations of this zone. The radon existence on the fault zone is slighly higher than other locations. Thus, it is interesting to determine the gross alpha and beta radioactivity concentrations in the water and soil of the same location where the soil radon monitoring was done to determine whether there was any correlation between radioactivity concentration and soil radon or not. Determination of the gross alpha and gross beta radioactivity concentrations were done by using ZnS (Ag) and beta sensitive plastic detectors, respectively. The obtained results for both measurements were concluded.

Keywords: Gross Alpha, Gross Beta, Sivrice Fault Zone

1. Introduction

The effects of the background radioactivity variation of the natural radiation that people are always exposed to depends on the regional geological and geographical behavior. The radioisotopes in soil dissolve into the surroundings by water and thus this reaction produces a background level of natural radiation in it (Duenas et al. 1993; Canbazoğlu et al. 2000; Canbazoğlu et al. 2001).

The environmental gamma radioactivity and the gross alpha and beta radioactivity in the soil and water collected from the fault zone are several times higher than those of other regions that are far away from the zone. There are also obvious differences of radon existence between these zones and the ones far away from them (Doğru et al. 2001).

A very important amount of the natural background radiations depends on the geological and geographical structure of the region. The radio-isotopes existing in soil could be dissolved in the water touching the soil around it and constitute natural background radiation concentration in waters. The activities of ^{137}Cs, ^{134}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu and ^{240}Pu isotopes are relatively higher in the soil. Approximately 100% of ^{137}Cs activity is transferred to the interacting materials (Hoshi et al. 1994).

Natural radionuclide such as ^{238}U, ^{232}Th and ^{40}K in soil cause the soil to be radiation contaminated. They are usually found in high concentrations in volcanic rocks (especially in granite), pegmatites and hydrothermal accumulations (NCRP 1975; Banks et al. 1995; Doğru et al. 2001). Since the water always interacts with its surroundings there is a high probability of radionuclide existing in soil to be passing through the rocks into the waters (Canbazoğlu et al. 2000).

In this study, the gross alpha and beta radioactivity concentration level in water and soil samples of Sivrice (Elazığ) fault zone were investigated.

2. Materials and Methods

The water samples that obtained around the continuously soil radon monitoring stations were collected in 1L pre-cleaned bottles. 0.5 mL 3 N nitric acid was added to prevent precipitation and absorption of the sample by container walls (Özmen et al. 2004). The water samples were transferred to 100 mL glass cups and evaporated at 60°C without boiling until a small amount remained. The residuals are transferred to aluminum planchets for counting.

The soil samples were prepared by rending to powder in small size. Then the soil samples were put in labeled aluminum foils and were oven-dried at 105°C. After the oven-drying process, the powdered soil samples were transferred to the planchets by adding pure water to hold the samples in their sample's holder.

Determination of the gross alpha and beta radioactivity concentration of the samples were made by using 7286 Low Level Alpha Counter with ZnS scintillator and SR8 Counter with beta assay scintillator, respectively. Counting systems were calibrated by using the relevant guidebooks (Instruction Manual for Windowless Scintillation Counter, Type 6001, NE Technology Limited, UK; 7286 Low Level Alpha Counter User Manual, Littlemore Scientific Eng. (ELSEC), UK)

The radioactivity concentrations of the prepared samples were calculated by using the following equations.

$$A_\alpha = (N \times ECF)/2.22$$

$$A_\beta = (0.391 \times R \times N_m)/N_0$$

Where; A_α is the alpha-activity, N is the sample net alpha count per minute, ECF is the efficiency correction factor, $\boldsymbol{A_\beta}$ is the beta-activity, R is the sample net beta

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count per minute, N_m is the sample specific mass in mg.cm-2 and N_0 is the activity read from the beta self-absorption curve for each sample thickness (Canbazoğlu et al. 2001).

3. Results and Discussion

The gross alpha and beta radioactivity concentrations in water and soil samples obtained from different four locations in Sivrice Fault Zone of the East Anatolia Fault System are respectively presented in Table 1-2 and Figure 1-2.

As shown in the Table 1, the gross alpha radioactivity concentrations in water varies between 0.118±0.018 Bq/L and 0.618±0.074 Bq/L and the gross beta radioactivity concentrations varies between 0.018±0.014 Bq/L and 0.226±0.012 Bq/L. The water sample labeled as IV-3 has the highest value while the sample labeled as II-2 has the lowest value for gross alpha radioactivity concentrations.

Table 1. The gross α and β radioactivity concentration of the water samples

Samples	Gross α Radioactivity Concentration (Bq/L)	Gross β Radioactivity Concentration (Bq/L)
I-1	0.120±0.017	0.018±0.014
I-2	0.374±0.023	0.134±0.010
I-3	0.135±0.022	0.187±0.011
II-1	0.430±0.021	UDL*
II-2	0.118±0.017	0.226±0.012
II-3	0.245±0.018	0.179±0.011
III-1	0.196±0.018	0.123±0.011
III-2	0.455±0.062	0.123±0.004
III-3	0.243±0.022	0.212±0.010
IV-1	0.526±0.046	0.118±0.005
IV-2	0.244±0.075	0.061±0.006
IV-3	0.618±0.074	0.093±0.008

*:UDL: Under Detection Limit

The sample II-2 has the highest gross beta radioactivity concentrations while the sample I-1 has the lowest gross beta radioactivity concentrations. These examined results show that although the water sample numbered II-2 has the highest gross beta radioactivity concentrations, the gross alpha radioactivity concentrations has the lowest value. This is the usual case as commonly seen (Doğru et al. 2002ab).

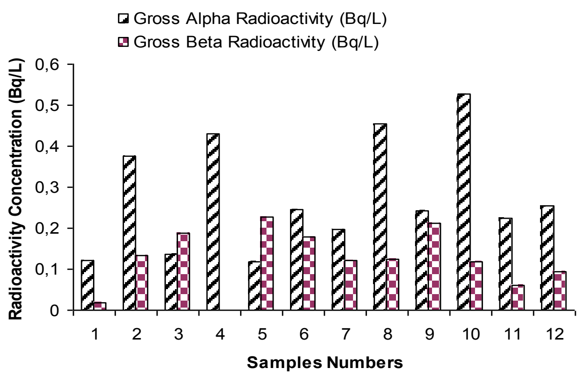

Figure 1. The gross alpha and beta radioactivity concentration of the water samples.

As is shown in the Table 2, the gross alpha radioactivity concentrations in soil varies between 0.206±0.081 Bq/g and 0.837±0.025 Bq/g and the gross beta radioactivity concentrations between 0.111±0.025 Bq/g and 0.423±0.025 Bq/g.

Table 2. The gross alpha and beta radioactivity concentration of the soil samples

Samples	Gross α Radioactivity Concentration (Bq/g)	Gross β Radioactivity Concentration (Bq/g)
I-1	0.430±0.073	0.236±0.020
I-2	0.412±0.072	0.325±0.026
I-3	0.206±0.081	0.194±0.025
II-1	0.837±0.092	0.423±0.025
II-2	0.450±0.082	0.271±0.027
II-3	0.781±0.074	0.416±0.025
III-1	0.316±0.080	0.240±0.024
III-2	0.431±0.082	0.325±0.024
III-3	0.660±0.083	0.111±0.025
IV-1	0.262±0.071	0.176±0.024
IV-2	0.244±0.075	UDL
IV-3	0.618±0.074	0.316±0.024

*:UDL: Under Detection Limit

The sample II-1 has the highest gross alpha radioactivity concentrations while the sample I-3 number has the lowest gross alpha radioactivity concentrations. The sample II-1 has the highest gross beta radioactivity concentrations while the sample III-3 has the lowest gross beta radioactivity concentrations.

It is interesting that the soil sample II-1 has high concentration both in gross alpha and gross beta radioactivity when compared to the other soil samples. This is resulted from the geological structure of the location from which the sample was obtained.

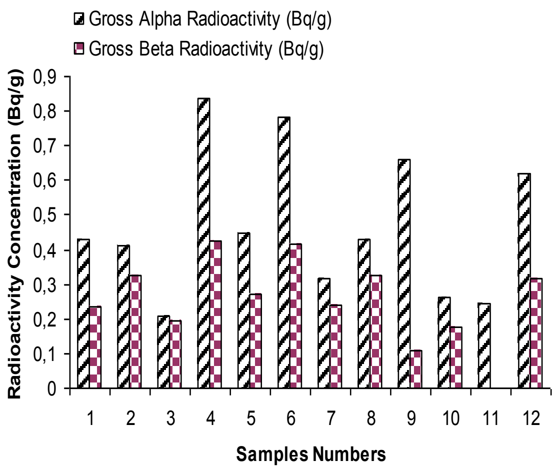

Figure 2. The gross alpha and beta radioactivity concentration of the soil samples.

As shown in the Figure 1 and Figure 2, respectively; 83% of the water samples and 100% of the soil samples have higher gross alpha radioactivity than gross beta radioactivity. Such a result may due to the location of the stations from which both the water and soil samples were obtained whis is situated on the Fault Zone and where the radon existence is relatively high.

Acknowledgments

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