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Determination of gross α and β activities in waters from Batman, Turkey

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Abstract

The city of Batman, located in the southeastern part of Turkey, has lately been receiving national attention because of its oil reserves and production, and cultural, tourist attractions and rapid industrialization. There is no information about radioactivity measurement reported in water samples in the Batman province so far. For this reason, the concentrations of gross α and β radioactivity in water samples collected from 16 different sampling stations in Batman have been determined. The instrumentation used to count the gross α and β activities was an α/β counter of the low background multiple detector type with 10 sample detectors (Berthold LB770). The obtained results showed that natural activity concentrations of α- and β-emitting radionuclides in drinking water, river water and well water samples are within the range recommended by WHO, while thermal spring water is not in this range. Gross α and β activities of tap, well and river waters range from 10.8 mBq.l^{-1} to 73.4 mBq.l^{-1} and from 3 mBq.l^{-1} to 347 mBq.l^{-1}, respectively. Concentration of thermal spring water is 3909.5 and 2097 mBq.l^{-1} for gross α and β, respectively. The gross β activities are generally higher than the corresponding gross α activities. The results obtained in this study indicate that the individual effective doses are below the WHO recommended reference level of 0.1 mSv.y^{-1} for all water samples, except for the thermal spring water, and shows no significant departure from the other parts of the country.

Keywords: Gross α and β; Water; Batman

1. Introduction

Human beings have been exposed to radiation from the natural environment throughout history. Environmental radiation originates from a number of naturally occurring and man-made sources. The largest proportion of human exposure to radiation comes from natural sources of external radiation, including cosmic and terrestrial radia-

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tion and from inhalation or ingestion of natural radioactive materials. The United Nations Scientific Committee on the Effects of Atomic Radiation has estimated that exposure to natural sources contributes >70% of the population radiation dose and the global average human exposure from natural sources is 2.4 $mSv.y^{-1}$ (cosmic ray 0.4, terrestrial gamma ray 0.5, radon 1.2, and food and drinking water 0.3) [1].

Water is an important parameter of environmental science as it is indispensable to human life. Radioactivity present in waters is mainly due to the presence of radioactive elements in the earth's crust. Recently, other artificial radionuclides have appeared owing to human activities such as nuclear power plants, nuclear weapons testing and manufacture and use of radioactive sources. In addition, human activities such as mining, milling and processing of uranium ores and mineral sands, manufacture of fertilizers, and burning of fossil fuels have raised naturally occurring radioactive material concentrations in the environment [2].

Radioactive material can reach surface waters in different ways from each of the processes or activities that produce technologically enhanced radioactive material. River water can be contaminated by surface run-off rainwater transporting leached radionuclides from cities, mine waste, agricultural areas, and so on [3]. The contributions from technologically enhanced radioactive materials are normally limited by regulatory control of the source or practice. Remedial action should be taken through this regulatory mechanism that in the event that such sources cause concern by contaminating drinking water [4].

Waters contain both α and β emitters in widely varying concentrations which are responsible for a generally small fraction of the total dose received from natural and artificial radioactivity [4]. Therefore, different countries have established their own water quality standards to meet their national priorities, taking into account their economic, technical, social, cultural and political

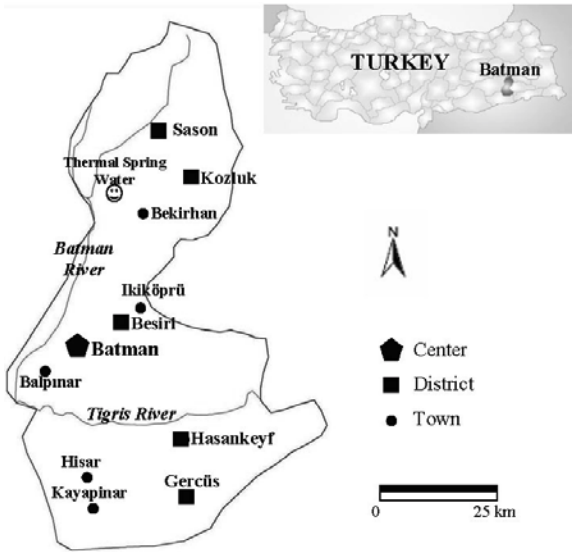

Fig. 1. Location of sampling sites indicating the Batman Province, Turkey.

requirements [5]. For practical purposes, the recommended guideline activity concentrations are 0.5 $Bq.l^{-1}$ for gross α and 1 $Bq.l^{-1}$ for gross β activity [6]. The recommendations do not show any difference between naturally occurring and artificial or man-made radionuclides. Below these reference levels of gross activity, drinking water is acceptable for human consumption and any action to reduce radioactivity is not necessary. In recent years, there have been many studies of gross α and β activities in sources such as bottles, drinking, river, and wells [7–13].

Batman, one of the southeastern Anatolian cities (Turkey) with a population of approximate 500,000, is a province which takes its name from the river flowing on its western part. The province of Batman stands between the longitude of 41°10′–41°40′E and latitude of 38°40′–37°50′ N. The region spans an area of 4694 km^2 and is divided into six districts (Fig. 1). The province is important because of its oil reserves and production. Here is one of the main crude oil production centers of Turkey, and the refinery in