Journal of Radiation Research and Applied Sciences xxx (2015) 1–5

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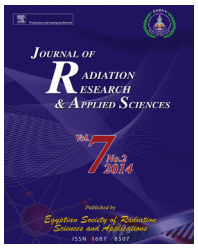

^{226}Ra and ^{210}Po concentration in drinking water of Cauvery river basin south interior Karnataka State, India

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ARTICLE INFO

Article history:
Received 18 February 2015
Received in revised form
7 May 2015
Accepted 15 August 2015
Available online xxx

Keywords:
Radium
Polonium
Radiation dose

ABSTRACT

Naturally occurring radionuclide ^{210}Po which is an element of ^{238}U decay series, contribute to the radiation that normally people are exposed. Drinking water samples collected from Cauvery river basin of south interior Karnataka State, India were analysed for the activity of ^{210}Po using radiochemical analysis technique. The estimated concentration of ^{210}Po in river water ranges from 0.86 to 4.49 mBq l^{-1}, and its mean value is 2.67 ± 1.09 mBq l^{-1}. The concentration of ^{210}Po in bore well water ranges from 1.89 to 4.18 mBq l^{-1} and its mean value is 3.22 ± 0.67 mBq l^{-1}. The dissolved radium concentration in river water varies from 9.09 mBq l^{-1} to 55.07 mBq l^{-1} with an average of 32.33 ± 14.16 mBq l^{-1}. Total ingestion dose rate due to ^{226}Ra and ^{210}Po varies from 2.61 to 15.00 μSv y^{-1} with a mean value of 8.95 ± 3.74 μSv y^{-1}, which is less than the recommended value by ICRP (International commission on radiological protection).

1. Introduction

The naturally occurring radionuclide ^{210}Po, which is an element of ^{238}U decay series, provides a significant contribution to the radiations that people are exposed. Naturally occurring radionuclides of terrestrial origin called primordial radionuclides are present in various quantities in the environment, including the human body. Only those radionuclide which have their half-lives comparable to the age of the earth, and their decay products, exist in significant quantities in these materials (UNSCEAR, 2000). Certain types of rocks have higher concentration of uranium and the concentration is 5 ppm in granites, syenites, pegmatite, acid volcanic rocks and gneisses (Beretka & Matthew, 1985; Murray, Olley, & Wallbrink, 1992; Somogyi, 1990).

Normally alpha emitting nuclei are decay products of uranium and thorium series in the natural environment. ^{222}Rn from ^{238}U series and ^{220}Rn from ^{232}Th series and their alpha emitting progenies are also important radionuclide from the radiological point of view. ^{222}Rn is an inert gas which can diffuse through solid matter and enters into the atmosphere. When ^{218}Po, ^{214}Po are inhaled it accumulates in lungs, resulting in lung cancer and other various health disorders (Carvalho & Fajgelj, 2013).

Radium (^{226}Ra), contribute significantly to the dosage through intake of water in to the human body. ^{226}Ra decays to radon (^{222}Rn) by emitting alpha particle. These decay products

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Peer review under responsibility of The Egyptian Society of Radiation Sciences and Applications.
http://dx.doi.org/10.1016/j.jrras.2015.08.001

Please cite this article in press as: Kavitha, E., et al., ^{226}Ra and ^{210}Po concentration in drinking water of Cauvery river basin south interior Karnataka State, India, Journal of Radiation Research and Applied Sciences (2015), http://dx.doi.org/10.1016/j.jrras.2015.08.001

also affects the health of people through the drinking water which is naturally a public concern. In addition, if uranium rich material lies near the surface, then it adds to the radiation problem faced by mankind (UNSCEAR, 1988; 1993).

1.1. *Study area*

The study area is the Cauvery river basin, of south interior Karnataka State, India (Fig. 1). River Cauvery is one of the major tributaries of the peninsular flowing east and running into the Bay of Bengal. Cauvery rises at Talakaveri on the Brahmagiri range in the Western Ghats presently in the Coorg district of Karnataka state at an elevation 1341 m (4400 ft) above mean sea level. The catchment area of the entire Cauvery basin is 81,155 Sqkm including the other basin states of Cauvery river system and 34,273 Sqkm of Karnataka. The basin lies between North latitude 10° 05′ to 13° 30′ and East longitudes 75° 30′ to 79° 45′. The principal soil types found in the basin are black soil, red soil, laterites and alluvial soil. The Geology of the drainage basin is principally formed from granitic gnesis, charnockites, granite, phyllites, slates, schists with chlorite, biotite, garnet and hornblende (Naqvi, Viswanathan, & Viswanatha, 1978; Ramakrishnan, 2009; Sathish, Sannappa, Paramesh, Chandrashekara, & Ventaramaiah, 2001).

2. Materials and methods

2.1. *Radium in water*

Radium in water is analysed using radon emanometry technique. In the present study water sample of 20 L is collected in the polythene air tight prewashed container to analyse radium concentration in water. The samples were acidified with HNO_3 to avoid the adsorption of the actinides on the walls of the container. The water samples were filtered using whatman 42 filter paper in order to remove the soil and dust particles in it (Chandrashekara, Veda, & Paramesh, 2012; Sethy, Jha, Ravi, & Tripathi, 2014).

The water sample was co-precipitated with MnO_2, then pre-concentrated by evaporation and chemical method to estimate the activity of ^{226}Ra. Pre-concentrated samples of about 70 ml was transferred into the radon bubbler to build up radon initially. The radon in the solution is removed with the help of a low suction pump. The schematic diagram of radon bubbler is shown in Fig. 2.

After aeration is complete the bubbler is sealed and allowed for radon to build up and accumulate in the solution (Raghavayya, 1990). The buildup period is determined by the expected radium content and is generally about 7 half life of radon which is about 21 days. The accumulated radon is transferred to evacuated scintillation cell (150 cm^3). This is connected to a radon bubbler through rubber tubing, which was well sealed from atmosphere. On agitating the water in the bubbler the dissolved radon gets desorbed and enters into the scintillation cell by vacuum transfer. Alpha activity of the scintillation cell was counted using alpha probe and counting system specially designed for this purpose.

Total radium dissolved in the solution taken is given by

$$^{226}Ra\,(\mathrm{Bq\,L^{-1}}) = \frac{6.97 \times 10^{-2} \times D}{V \times E \times (e^{-\lambda T}) \times (1 - e^{-\lambda \theta}) \times (1 - e^{-\lambda t})}$$

Where,

- D = counts above background
- V = Volume of water
- E = Efficiency of the scintillation cell (74%)
- λ = decay constant for radon (2.098×10^{-6} s^{-1})
- T = Counting delay after sampling
- t = Counting duration
- θ = build up time in the bubbler

2.2. *Polonium in water*

Sampling procedure

Drinking water samples collected from Cauvery river basin of south interior Karnataka State was analysed for the

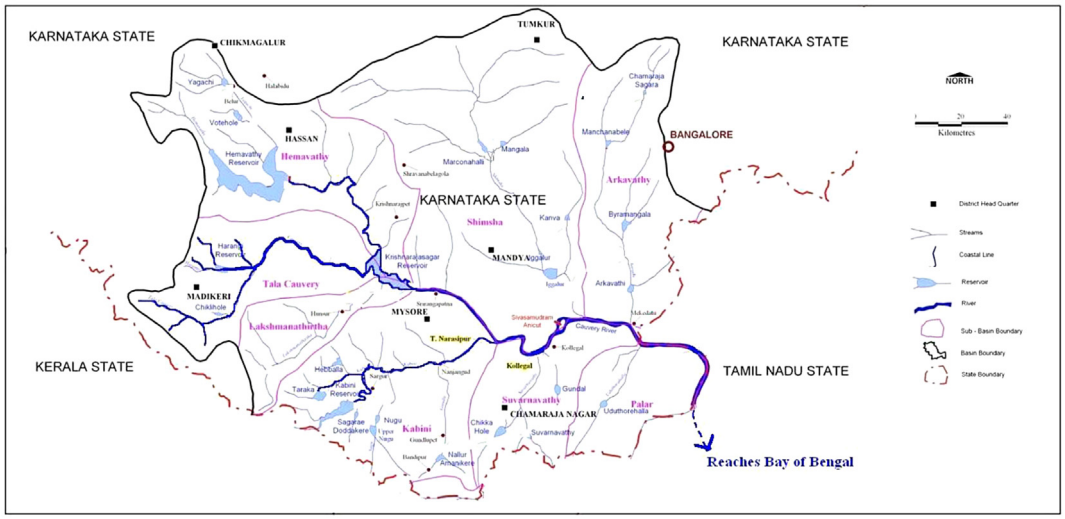

Fig. 1 – Study area.

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