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A comparative study of the radiological hazard in sediments samples from drinking water purification plants supplied from different sources

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ABSTRACT

The natural radiation level has been determined for 135 sediment samples from forty-six drinking water purification plants supplied from different sources (Nile River, Ibrahimia Canal and Bahr Yousif Canal) aiming to evaluate the radiation hazard. The concentration of natural radionuclides (^{226}Ra, ^{232}Th and ^{40}K) has been investigated by using gamma spectrometry (NaI (Tl) 3″ × 3″) detector. The results showed that the concentrations of average activity in the sediment samples collected from Nile River, Ibrahimia Canal and Bahr Yousif Canal are (29 ± 2, 30 ± 2 and 240 ± 8 Bq kg^{-1}), (47 ± 3, 46 ± 8 and 258 ± 12 Bq kg^{-1}) and (28 ± 2, 27 ± 3 and 219 ± 18 Bq kg^{-1}) for ^{226}Ra, ^{232}Th and ^{40}K, respectively. The distributions of average activity concentrations of samples under investigation are within the world values although some extreme values have been determined. Radiological hazard effects such as: absorbed dose rate (D), outdoor and indoor annual effective dose equivalent (AEDE), radium equivalent activities (Ra_{eq}), hazard indices (H_{ex} and H_{in}), gamma index (I_γ), excess lifetime cancer risk (ELCR) and annual gonadal dose equivalent (AGDE) for the corresponding samples were also estimated.

1. Introduction

Natural radionuclides have been components of earth since its existence and widely spread in earth's environment. There are many naturally occurring radionuclides in environment, containing uranium and thorium series radioisotopes and natural ^{40}K. These natural radionuclides exist in soil, sediment, water, plants and air. Natural environmental radioactivity and associated external exposure due to gamma radiation depend primarily on the geological conditions and soil and sediment formations of each region in the world (Aközcan, 2012), hence it plays a role in accumulating and transporting contaminants within the geographic area, as

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well as it considered environmental host of the waste, which is charged by natural or artificial processes (Suresh, Ramasamy, Meenakshisundaram, Venkatachalapathy, & Ponnusamy, 2011a).

Sediments of drinking water purification station are detritus products of rocks and bear the mineralogical properties of the original rock formation. Among the various building materials, sediment (or deposits of drinking water purification station) is one of the most important and major mixing materials for building construction in Egypt, especially in Upper Egypt. In addition to being the main source of continuous radiation exposure to human, sediment acts as a medium of migration for transfer of radionuclides to the biological systems and hence, it is the basic indicator of radiological contamination in the environment. Natural radionuclides in river sediment generate a significant component of the background radiation exposure of the population (Suresh, Ramasamy, Meenakshisundaram, Venkatachalapathy, & Ponnusamy, 2011b). Therefore, the knowledge of the concentrations and distributions of the natural radionuclides in the deposit samples are of great interest since it provides useful information in monitoring of environmental contamination and associated human health by natural radioactivity.

Man-made or anthropogenic radionuclides are created via human activities, which vary with time and location. Sources of man-made radionuclides are divided into nuclear and non-nuclear industries. Mining (especially uranium and thorium), phosphate fertilizers manufacture, agricultural applications, coal combustion, cement production, street construction and other human activities are non-nuclear industries which have

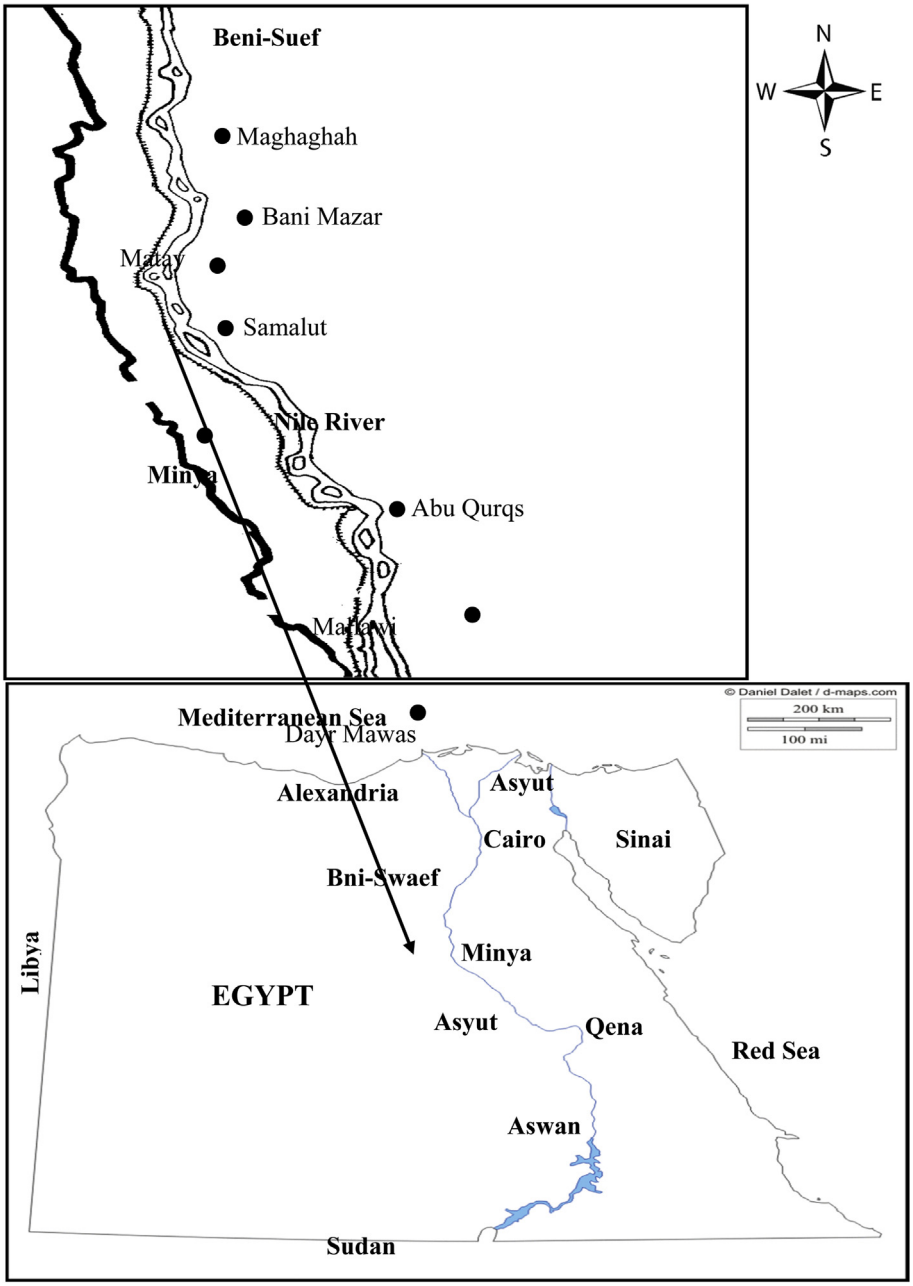

Fig. 1 – Map of sediment samples locations.