Radiological characterization, car-borne survey and radioecological risk assessment of soils from Ghazaouet, Western Algeria

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Abstract:

Human exposure to ionizing radiation, both indoors and outdoors, primarily arises from natural background radiation. This radiation is emitted by terrestrial radionuclides found in the Earth's crust along with their decay products, as well as by cosmic radionuclides.

Human beings can be exposed to artificial radioactivity, such as Cesium-137 (^{137}Cs), primarily generated through nuclear fission, and understanding the exposure pathways is essential for evaluating health risks.

The main objectives of this research are to assess the levels of natural background gamma radiation, to analyse both natural and man-made radionuclide concentrations in surface and core soils, and to conduct a risk assessment using the ERICA tool.

Natural background gamma radiation was measured along roads in the vicinity of Ghazaouet (western Algeria) using a car-borne spectrometer system (FHT 1376 Mobysis).

A total of 20411 data of the background gamma dose rate were collected during December 2021.

A total of seventeen (17) surface soil samples and one core soil sample were collected from the western region in March 2023. The detailed methodology applied for the treatment and analysis by HPGe gamma spectrometry was described in Taieb Errahmani et al.,(2020)**[1]**.

The ERICA tool was used to assess the radiological risk of the region. This was based on the activity concentrations of radionuclides detected in the soils.

The measured dose rate was found to be in the range of 8.6-62.1 nSv.h^{-1} with a mean value of 35.35 nSv.h^{-1}. The background gamma dose rate was mapped using Map Info software.

The radionuclides that were analyzed in soil by gamma spectrometry were ^{238}U daughters (^{210}Pb , ^{234}Th, ^{226}Ra, ^{214}Pb and ^{214}Bi), ^{232}Th daughters (^{212}Pb, ^{208}Tl and ^{228}Ac), ^{137}Cs and ^{40}K.

The spectrometric analysis indicated that the surface soils contained ^{137}Cs with an average activity concentration of 11.73 ± 0.58 Bq/kg. In contrast, the soil core samples showed a decreasing presence of ^{137}Cs down to a depth of 25 cm, where it had an average activity concentration of 2.41 ±0.13 Bq/kg, which is very low compared to ^{137}Cs detected in soils from a high altitude site **[2]**.

Activity concentrations (Bq·kg^{-1} d.w.) in soil core were found to be in the range of 153.55±6.96–387.18±15.63 (^{40}K), 13.68 ±4.26–50.26±15.65 (^{210}Pb), 9.05±0.48–18.88±1.23 (^{214}Bi),13.01±1.23–28.88±2.74 (^{228}Ac).

The total dose rates for lichens and bryophytes assessed using the ERICA tool were found to be significantly elevated compared to other environmental matrices, measured at **16 µGy h^{-1}**, which does not pose a radiological health risk.

References:

[1] **Taieb Errahmani, D.,** Noureddine, A., Abril Hernandez,J.M., Boulahdid, M., 2020. Environmental radioactivity in a sediment core from Algiers Bay: radioecological assessment, radiometric dating and pollution records. *Quaternary Geochronology , 56.*

[2] **Taieb Errahmani D**., Noureddine A., Abril J.M., 2022. Depth-distributions and migration of fallout radionuclides in mountain soils from Chréa National Park (Algeria): The role of rhizospheres. *Journal of Environmental Radioactivity*,Vol.242, 106799.