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Gamma-ray spectroscopy and its associated radiological risk of beach sand and soil samples from Zanzibar, United Republic of Tanzania

In this study, the activity concentration of natural radionuclides (K-40, and Th-232 and U-238 decay products) in beach sand and soil samples from Zanzibar were measured using a combination of in-situ and ex-situ gamma-ray spectroscopy. The in-situ gamma-ray survey was conducted using the Multi Element Detector for Underwater Sediment Activity (MEDUSA) detector. Activity concentrations of the natural radionuclides (K-40, and Th-232 and U-238 decay products) were extracted from the MEDUSA spectra using the Full Spectrum Analysis (FSA) procedure; and spatial distribution maps for K-40, Th-232 and U-238) were plotted. The collected beach sands and soil samples were analysed ex-situ using a Hyper-Purity Germanium detector (HPGe).

The activity concentration of K-40, and Th-232 and U-238 decay products in beach sands were found to have enhanced radioactivity levels due to the presence of heavy minerals. The spatial distribution maps for K-40, Th-232 and U-238 show large variation in xoil samples for the two relatively small islands, Unguja and Pemba.

The average outdoor absorbed gamma dose rate in air and annual effective dose equivalent were also calculated in this study. The highest abzorbed dose rates in xoil xamples and beach sand are respectively 5 and 38 times higher than the average world level of 57 nGy/h for terrestrial doses. The annual effective dose equivalent in most soil samples were higher than the world average value of 0.07 mSv/y; and low in most beach sands with an exception of black sand samples collected from Kukuu beach. From radiological point of view, there is no significant radiollgical risk for humans using Zanzibar beaches for various activities.

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