Contribution ID: **107** Type: **Oral**

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

Wednesday, 18 May 2022 14:00 (30 minutes)

Everyone on the planet is exposed to some background radiation. Human exposure to ionising radiation is one of the scientific subjects that attract public attention, since radiation of natural origin is responsible for most of the total radiation exposure of the human exposure.
This study presents the results of Gamma-ray spectroscopy and its associated radiological risk of beach sand and soil samples from Zanzibar, United Republic of Tanzania. The activity concentration of natural radionuclides (40K, and 232Th and 238U decay products) in beach sand and soil samples 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 Sediment Detector for Underwater Sediment Activity (MEDUSA) detector. The detector was mounted on the front of a 4×4 vehicle, 60 cm off the ground. Activity concentrations of the primordial radionuclides were extracted from the MEDUSA spectra using the Full Spectrum Analysis (FSA) procedure. The collected beach sands and soil samples from the beaches and the land mapped using the MEDUSA detector were analysed using a Hyper Purity Germanium (HPGe) detector.
The activity concentrations of 40K, 238U and 232Th in beach sand are much lower than in soil samples, with one major exception at Kukuu. Two beach sand samples from Kukuu beach were found to have enhanced radioactivity levels due to the presence of heavy minerals.
The spatial distributions maps for 40K, 238U and 232Th show large variation in soil samples for two relatively small islands. These strong variations are unexpected, that could have implications for agriculture.
The outdoor gamma dose rates obtained in beach sand and soil samples ranged from 3 to 2156 nGy h-1 and 50 to 294 nGy h-1, respectively. The highest absorbed dose rates in soil samples and beach sand are respectively 5 and 38 times higher than the average world level of 57 nGyh-1 for terrestrial doses. Apart from the Kukuu black sand samples that contain the high 238U and 232Th levels, the beach sands and soil in this study do not pose any radiological threat to the public using beaches for various activities.

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Session Classification: Environmental Applications