

## Spatial Distribution of Natural Radionuclides in Soil, Sediment and Waters in Oil Producing Areas in Niger Delta Region of Nigeria

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**Abstract :** Activity concentrations of natural radionuclides ( $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$ ) in the soil, sediment and water of oil producing communities in Delta and Rivers States were determined using  $\gamma$ -ray spectrometry. The mean soil/sediment activity concentration of  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  in onshore west in Delta state is  $40.2 \pm 5.1 \text{ Bqkg}^{-1}$ ,  $29.9 \pm 4.2 \text{ Bqkg}^{-1}$  and  $361.5 \pm 20.0 \text{ Bqkg}^{-1}$  respectively, the corresponding values obtained in onshore east1 of Rivers state is  $20.9 \pm 2.8 \text{ Bqkg}^{-1}$ ,  $19.4 \pm 2.5 \text{ Bqkg}^{-1}$  and  $260.0 \pm 14.1 \text{ Bqkg}^{-1}$  respectively. While the mean activity concentration of  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  in onshore east2 of Rivers state is  $29.3 \pm 3.5 \text{ Bqkg}^{-1}$ ,  $21.6 \pm 2.6 \text{ Bqkg}^{-1}$  and  $262.1 \pm 14.6 \text{ Bqkg}^{-1}$  respectively. These values obtained show enhanced NORMs but are well within the world range. All the radiation hazard indices examined in soil have mean values lower than their maximum permissible limits. In drinking water, the obtained average values of  $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$  and  $^{40}\text{K}$  is  $8.4 \pm 0.9$ ,  $7.3 \pm 0.7$  and  $29.9 \pm 2.2 \text{ Bql}^{-1}$  respectively for well water,  $4.5 \pm 0.6$ ,  $5.1 \pm 0.4$  and  $20.9 \pm 2.0 \text{ Bql}^{-1}$  respectively for borehole water and  $11.3 \pm 1.2$ ,  $8.5 \pm 0.7$  and  $32.4 \pm 3.7 \text{ Bql}^{-1}$  respectively for river water in onshore west. For onshore east1, average activity concentration of  $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$  and  $^{40}\text{K}$  is  $8.3 \pm 1.0$ ,  $8.6 \pm 1.1$  and  $39.6 \pm 3.3 \text{ Bql}^{-1}$  respectively for well water,  $3.8 \pm 0.8$ ,  $4.9 \pm 0.6$  and  $35.7 \pm 4.1 \text{ Bql}^{-1}$  respectively for borehole water and  $5.5 \pm 0.8$ ,  $5.4 \pm 0.7$  and  $36.9 \pm 3.8 \text{ Bql}^{-1}$  respectively for river water. While in onshore east2 average value of  $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$  and  $^{40}\text{K}$  is  $10.1 \pm 1.1$ ,  $8.3 \pm 1.0$  and  $50.0 \pm 3.9 \text{ Bql}^{-1}$  respectively for well water,  $4.7 \pm 0.9$ ,  $4.0 \pm 0.4$  and  $28.8 \pm 3.0 \text{ Bql}^{-1}$  respectively for borehole water and  $7.7 \pm 0.9$ ,  $6.1 \pm 0.8$  and  $27.1 \pm 2.9 \text{ Bql}^{-1}$  respectively for river water and the average activity concentrations in the produced water  $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$  and  $^{40}\text{K}$  is  $5.18 \pm 2.14 \text{ Bql}^{-1}$ ,  $6.04 \pm 2.48 \text{ Bql}^{-1}$  and  $48.78 \pm 13.67 \text{ Bql}^{-1}$  respectively. These values obtained are well above world average values of 1.0, 0.1 and  $10 \text{ Bql}^{-1}$  for  $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$  and  $^{40}\text{K}$  respectively, those of the control site values and most reported values around the world. Though the hazard indices (Raeq, Hex, Hin) examined in water is still within the tolerable level, the committed effective dose estimated are above ICPR 0.1 mSvy $^{-1}$  permissible limits. The overall results show that soil and sediment in the area are safe radiologically, but the result indicates some level of water pollution in the studied area.

**Keywords :** radioactivity, soil, sediment and water, Niger Delta, gamma detector

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