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Determination of 226Ra/238U and 228Ra/232Th disequilibrium in surface soils from HBRA, Odisha, India and its radiological implications

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Naturally occurring radionuclides of terrestrial origin are ubiquitous in the Earth's crust. The radionuclides which are responsible for the enhanced natural background radioactivity are 238U, 232Th and their decay products. Therefore, it is necessary to monitor the environmental behavior of the naturally occurring radionuclides and radiation patterns in the HBRAs to increase awareness with public health risks. Radiological investigations have been carried out in the eastern coastal area of Odisha, India to measure gamma dose rate and natural radionuclide concentration in selected surface soil samples. 238U and 232Th were measured using inductively coupled plasma mass spectrometry (ICP-MS) and high purity germanium (HPGe) gamma spectroscopy was used for 226Ra, 228Ra and 40K. The high concentration of 232Th in soil increased the absorbed dose rate in air to the maximum of 748 nGy/h. The ratios of 226Ra/238U and 228Ra/232Th in soil at radioactive secular equilibrium are 1. In this study 226Ra/238U and 228Ra/232Th ratios ranged from 2.9 to 5.6 and 0.8 to 2 respectively. The ratios of 228Ra/232Th in soil show radioactive secular equilibrium, whereas 226Ra/238U ratios are > 1 with an absolute difference 2.9. The ratios of 226Ra/238U clearly exhibiting the radioactive disequilibrium in soil. In order to understand the environmental behavior of the radionuclides, plots were performed between 228Ra/238U and 226Ra/238U (Fig 1(A)); 226Ra/238U and total labile 238U (Fig 1(B)). Fig 1(A) shows strong positive correlation R2 = 0.90 and Fig 1(B) shows correlation R2 = 0.42. This suggests that geochemical nature of U is highly mobile or it is intensively leaching from the surface soil than 226Ra. High values of 226Ra/238U disequilibrium are associated with depletion of 238U. Therefore, the radioactive disequilibrium data between 226Ra and 238U is crucial to predict the geochemical mechanism such as the dissolution or migration of 238U from surface soil. For detailed understanding of this phenomenon physico-chemical characteristics of soils has also been carried out.

Fig. 1 (A) 226Ra/238U between 228Ra/232U; (B) 226Ra/238U between Total labile 238U

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