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Environmental Radioactivity : a case study in HHP granitic region of Tusham ring complex Haryana, India

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The paper presents the results of investigations of radon levels in the soil-gas, groundwater and indoor-air in the dwellings of the high heat producing (HHP)-granitic region of Tusham ring complex, Bhiwani District, Haryana. Radon release from soil and groundwater was found to be comparatively higher than the values observed in the nearby non-HHP/non-granitic regions of Punjab. The soil-gas and the groundwater radon concentration of HHP region of Tusham ring conmplex varies from 42.8±0.7 – 71.5±3.2 kBq m-3 with an average value of 61 kBq m-3, and 17.4±1.3 – 49.7±1.7 Bq l-1 with an average of 26.2 Bq l-1respectively, whereas in non-granitic/non-HHP regions the average value 31.5 (16.3±0.8–44.1±1.8) kBq m-3 and 7.9 (4.7±0.7–14.0±1.2) Bql-1 respectively have been observed. Indoor radon concentration in around 155 traditional dwellings in a wide range of villages situated in this HHP region has also been measured using the SSNTDs (LR-115) for two continuous years. Indoor radon levels in these dwellings in these dwellings have been found to be varying from 109 ± 80 to 1006 ± 55 Bq m-3 whereas the annual average radon values vary from 60 ±37 to 235 ±55 Bq m-3 for the dwellings of the villages studied in a non-HHP region of Amritsar District, Punjab. A positive correlation has been observed between the soil-gas and indoor radon levels particularly in the periphery of the exposed HHP rock formations, which may likely be the result of the imfluence of imbeded and exposed HHP granitic rocks and thus the active-soil formations.

In the present study, uranium concentration and radon exhalation rate in the wide range of soil/rock samples collected from this region, known to be composed of acid volcanics & associated HHP granites have been estimated. For comparative analysis, the soil samples from some districts of Punjab have also been analyzed for uranium estimation and radon exhalation rate. The ‘ CAN ’ technique using plastic track detector LR-115 type-II has been used for radon exhalation rate measurement, whereas the ‘Fission Track Registration’ technique has been employed for uranium content determination in these samples. The 222Rn exhalation rate in weathered granite area of the Tusham ring complex shows a maximum value 63.76 Bqkg-1 h-1, whereas the maximum value for uranium content has been found to be around 62.02 ppm. The corresponding values of exhalation rate and uranium content in soil samples of Punjab region are 11.54 Bq kg-1 h-1 and 13.41 ppm, respectively. A positive correlation between radon exhalation rate and uranium concentration has been observed for both soil and rock samples.

Slightly higher exhalation rates have been observed from samples collected from HHP granitic rock formation regions of the Tusham ring complex, as compared to other adjoining regions. It has also been observed that especially in dwellings situated on or around the exposed HHP granitic formations, where the indoor radon concentrations are higher, the gamma activities are also high and particularly for these places a good correlation (R2=0.64) has been observed between indoor radon and gamma activity, indicating that along with the surface-soil, the exposed HHP granitic rocks belonging to Malani igneous suite are actively contributing towards higher activities observed at certain places. Even a good positive correlation (R2=0.6) between soil-gas concentration and radon exhalation rate and also a positive correlation between soil-gas radon and indoor radon concentration (R2=0.5) and even between soil-gas radon concentration, exhalation rate and indoor radon level has been observed, which indicates that the presence of Ra/radon in collected soil/rock samples and then in surface air due to the distribution of omnipresent uranium, radium and hence the radon in soil/rock samples of the HHP region of Tusham ring complex. Certain specific locations within the periphery of well exposed HHP-granite rich formations clearly indicate the variation of soil-gas radon concentration with petrography of the region, contributing to the high indoor radon levels in these specific locations only.