平成２９年度　環境科学院　修士論文内容の要旨

Indoor airborne radioactivity measurement in dwellings near tailings dumps of abandoned gold/uranium mine in West Rand district, South Africa

(南アフリカ国ウエストランド郡の金・ウラン廃鉱の鉱滓堆積場周辺における住居室内空気の放射能測定)

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Due to the greatest deposit of gold ore near Johannesburg, where a gold rush commenced since 1886, the ore also contained uranium at a high concentration, many uranium-contaminated waste tailing dumps are distributed near the densely populated areas (Winde, 2016). Elevated concentration of uranium was detected in groundwater, livestock and agricultural crops (Hamman, 2012). Radon 222, the sixth progeny of uranium decay series, is an odorless natural radioactive gas which concentrates indoors and capable of causing lung cancer. World health organization recommends remedial action level of radioactivity in indoor air to be below 200 Bq/m^3 (WHO, 2009), but the West Rand areas has no known concentration. During dry times strong wind disperses dust in all directions, and the dust containing radioactive materials may be a problem. Therefore, in this research, we investigated the actual condition of dwellings that are adjacent to mine tailings.

For indoor air radioactivity measurement, polyethylene container mounted with a poly-allyl glycol carbonate plastic (CR-39) that is sensitive to alpha particles, was used to record alpha tracks. Seventy detectors were installed in 36 dwellings in September 2016, then recovered 4 months later. The CR-39 were later etched with 6.25M NaOH solution and alpha tracks were counted under optical microscope. The evaluated dwellings' indoor air radioactivity concentration was calculated based on the correlation factor between the radon concentration measured by RGD-PS3 and the track density obtained during laboratory experiment. Furthermore, gamma ray was measured from 12 soil samples of tailing dumps adjacent to dwellings and 26 soil samples inside dwellings' premises, after reaching the secular equilibrium in a container sealed for more than 30 days.

The indoor radioactivity values in the 36 dwellings were ranged from 23 to 315 Bq/m^3. Only four houses had higher radioactivity than the recommended WHO value (200 Bq/m^3), which were considered to be due to lack of proper ventilation and cracked floors compared with other houses. In-situ residential gamma-ray measurement at the 26 dwellings indicated 0.06–0.08 μSv/h, which were similar radioactivity at our school in Japan (ca. 0.07-0.09 μSv/h). The gamma-ray spectrometers (GEM20P4: SEIKO EG &G; ORTEC company) measurement also indicated that the radioactivity of uranium decay series nuclides (Bi-214 and Pb-214) in dwellings soils were similar with the ones of usual Japanese soils: e.g., average Bi-214 activity were around 180 Bq/kg. The Bi-214 radioactivity strength of the surface soil sample from three weathered tailing dumps and 5–70 cm depth soil from a probably relatively new tailing dump were 7–350 Bq/kg and 2100–4200 Bq/kg of Bi-214 radioactivity, respectively. The depletion of uranium on top surface layers of the tailings dumps is influenced by oxidized water, erosion and surface run-off. Although 88% of the residents from questionnaire survey were concerned about the seepage of dust containing radioactive particles influencing the level of indoor radioactivity, our study demonstrates that it may not be so serious in this stage.