

Final Referee Report – PhD Dissertation Defense

Candidate: Esther Osei Akuo-ko

Title: *The Role of Geology Formation and Anthropogenic Activities in Radionuclide Distribution in Selected Regions in Ghana*

University: University of Pannonia

Doctoral School: Chemical Engineering and Material Sciences

Reviewer: József Csurgai, PhD

The dissertation presented by Esther Osei Akuo-ko investigates the distribution of natural and artificial radionuclides in various environmental media—soil, sediment, water, and air—across several regions in Ghana. It specifically examines the influence of geological formations and human activities such as artisanal mining on radionuclide concentrations and associated radiological health risks.

This work is situated in the global context of radiological safety and environmental protection. Monitoring and evaluating the sources and levels of ionizing radiation in natural and built environments are critical to managing public exposure and guiding regulatory policies. The dissertation addresses knowledge gaps in baseline radionuclide distribution in Ghana, particularly in coastal and mining areas.

The novelty of the dissertation lies in its comprehensive, multi-media approach: measuring radionuclide concentrations across sediments, soils, indoor air, water, and even cigarette products. This holistic methodology provides a more complete understanding of environmental exposure pathways.

The candidate employed a robust combination of radiometric techniques (alpha and gamma spectrometry), standardized field sampling protocols, and statistical analyses. Geographic Information Systems (GIS) tools were used to create spatial distribution maps of radionuclide concentrations.

Key findings of the candidate works are emphasis as:

- Elevated levels of Ra-226, Th-232, and K-40 in sediments and soils from coastal and mining areas.
- Indoor radon concentrations in the Greater Accra region, with some exceeding WHO-recommended thresholds.
- High Rn-222 exhalation rates in soils near mining zones.
- Detection of Po-210 in cigarette samples, with estimations of induced radiation dose and cancer risk.

- Ground and surface water resources in mining zones showed radionuclide concentrations above international safety limits.

These results indicate a potential public health concern and provide actionable information for environmental policy makers and public health authorities in Ghana.

The candidate has produced commendable scientific output with:

- Five peer-reviewed publications as first author.
- 25 conference abstracts/presentations, with 15 oral contributions.

The thesis meets the formal and scientific standards of the Doctoral School. The structure is coherent, the literature review is thorough, and the results are well interpreted.

In conclusion, the candidate has satisfied all corrections and suggestions made previously and the dissertation meets the academical standards by University of Pannonia shows the candidate independent research capability. I recommend acceptance of the dissertation upon successful defense for the award of the PhD degree.

Questions for the Candidate at the Defense

1. Please clarify the process of gamma and radon sample preparation, particularly in relation to the minimization of radon losses during the setup for exhalation rate measurements.
2. What is the scientific basis for choosing a 3 cm soil depth in the exhalation chamber? How does this depth affect the results and their comparability to global standards?
3. Based on your findings, what concrete steps would you recommend to Ghanaian environmental or health authorities to mitigate public exposure to environmental radiation?

Date: 17.06.2025



József Csurgai PhD
associate professor