

Environmental radioactivity

INTRODUCTION

- In the environment, one finds both natural and artificial radioactive sources. This experiment focuses on the natural radionuclides present in rocks, air, etc.
- Principal natural radionuclides are ^{40}K and isotopes from primordial decay chains of ^{238}U , ^{235}U and ^{232}Th series (Figure 1).
- The distribution of natural radionuclides (e.g. radon, Figure 2) varies with the location in the geosphere and the processes which concentrate them.
- The major isotope of concern is radon. Due to its gaseous nature and the fact that it is an alpha-decay isotope, radon is responsible for the majority of the public exposure to ionizing radiation (Figure 3).

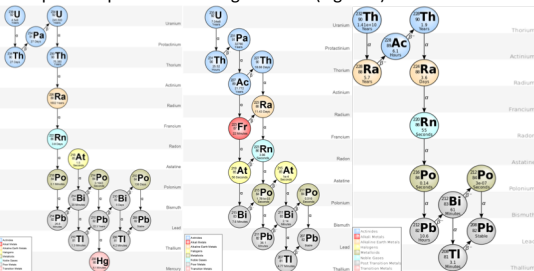


Figure 1. Natural decay chains: uranium, actinium and thorium series.

AIM AND MAIN OBJECTIVE

- The aim of this experiment is to understand and practically work with the concepts of radioactive decay, ingrowth and secular equilibrium, with a focus on radon and its progeny.
- The main objective of this experiment is to measure radon isotopes and its daughter nuclides in environmental samples such as rocks, air, water, etc.

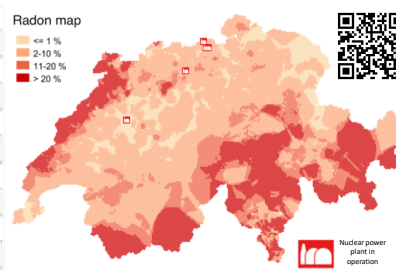


Figure 2. Radon map of Switzerland [1].

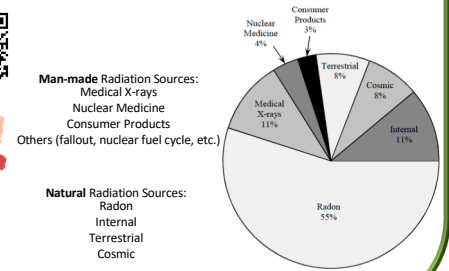


Figure 3. Ionizing radiation exposure to the public [2].

EXPERIMENTAL SETUP AND PROCEDURE

- We use a Ranger Radiation Alert (Figure 4) to measure radiation from radon decay products.
- The sample is placed in a sample holder (Figure 4) after initial treatment (homogenizing, weighting, etc., Figure 5).
- Radon decay products are trapped using different filters or activated carbon from air and water (e. g. Figure 6).

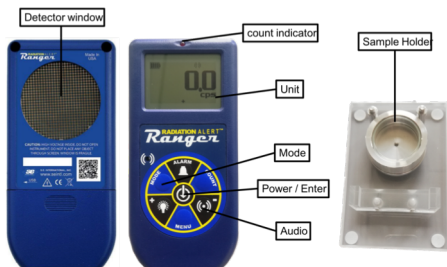


Figure 4. The Ranger and sample holder.



Figure 5. Balance.



Figure 6. Air filtration unit and filter.

- Workflow:** Background determination → Efficiency calibration → Measurement of environmental samples

EXAMPLES OF MEASUREMENTS

Ingrowth of ^{222}Rn products originating from a ^{238}U - rich rock. Secular equilibrium is reached after > 150 min.

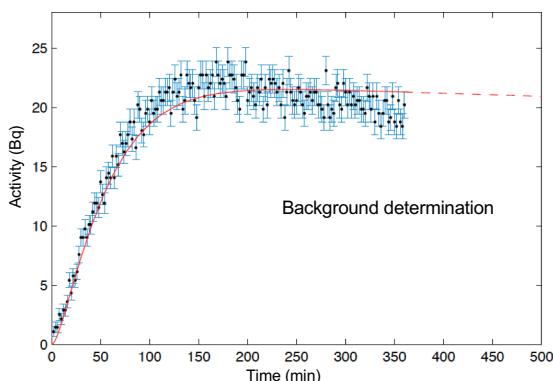


Figure 7. Measurement of rock rich in ^{238}U .

Decay of radon daughters present in dust particles and aerosols in little ventilated rooms such as the basement of HPF building.

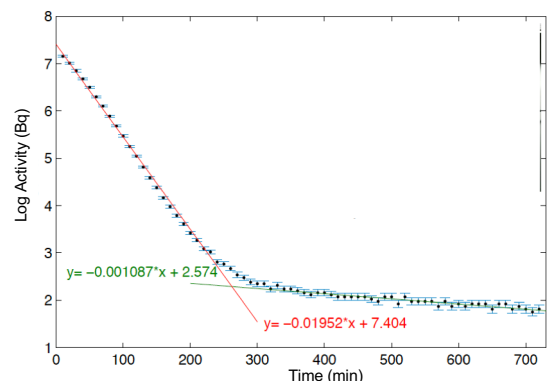


Figure 8. Measurement of air sample.

REFERENCES

[1] www.geo.admin.ch, [2] NCRP, Report No. 93, 1987