

Assessment of Radon in air and in water in the Portuguese-speaking African countries (PALOP)

Sandra Soares, Joaquim Kessongo, Yoenls Prata, Luis Peralta and Pedro Almeida



What is the reason to develop this study?

The problem of natural radioactive gas radon is an important problem of biology, ecology and radiation medicine.

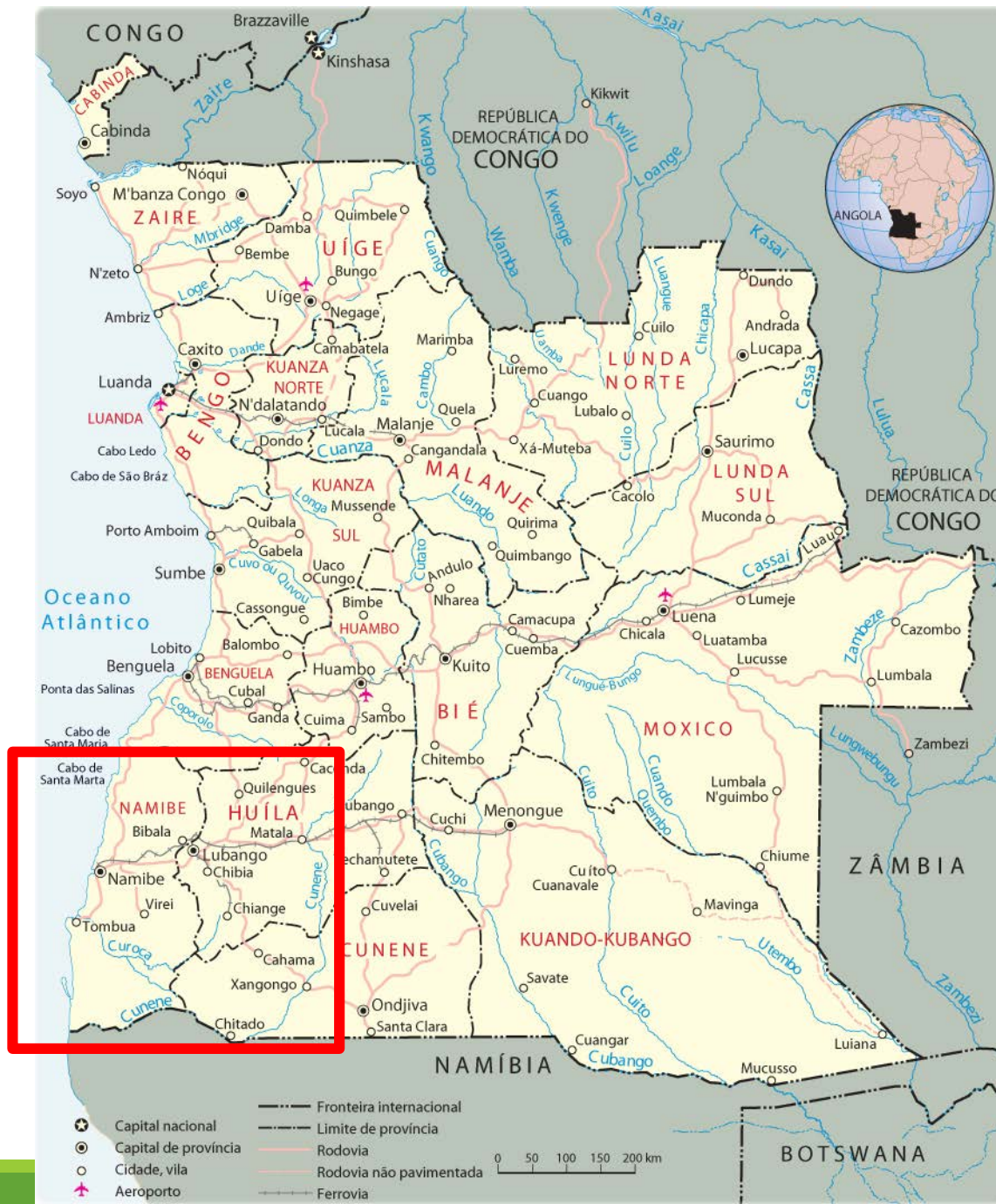
The main goal is the development of competencies that are essential to create and guarantee the fundamental conditions of scientific research in the field of health and life sciences in Portuguese-speaking African countries.

The aim of this work is:

- 1) To study the risks to human health, resulting from the inhalation of radon gas.

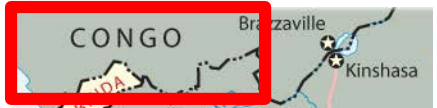
Measurements were made in public and residential buildings in the Lubango municipality (Huila Province);

- 2) To present an evaluation of radon concentration on water samples, used for human consumption, collected in the Bibala municipality (Namibe Province).



Most granitoid rock exposures occur throughout the **central-west** area of Angola, mainly in the **south-southwest** region.





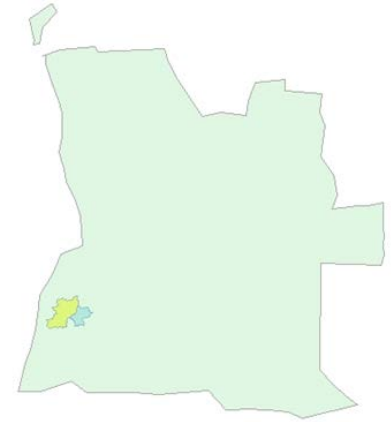
The granitoid lithologies are frequently distributed in all regions of Angola, especially in the **Northwest (Congo)**, **Northeast (Lunda)** and **South-southwest (Huila-Namibe-Bibala)**.

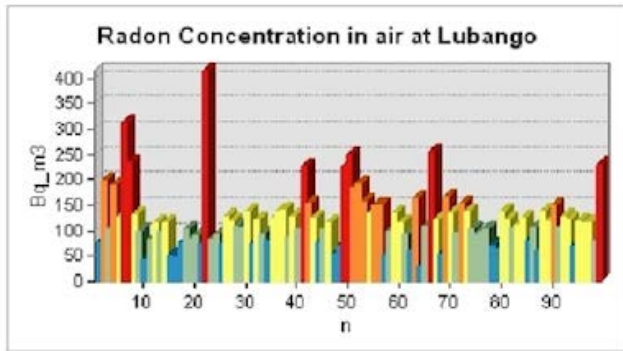
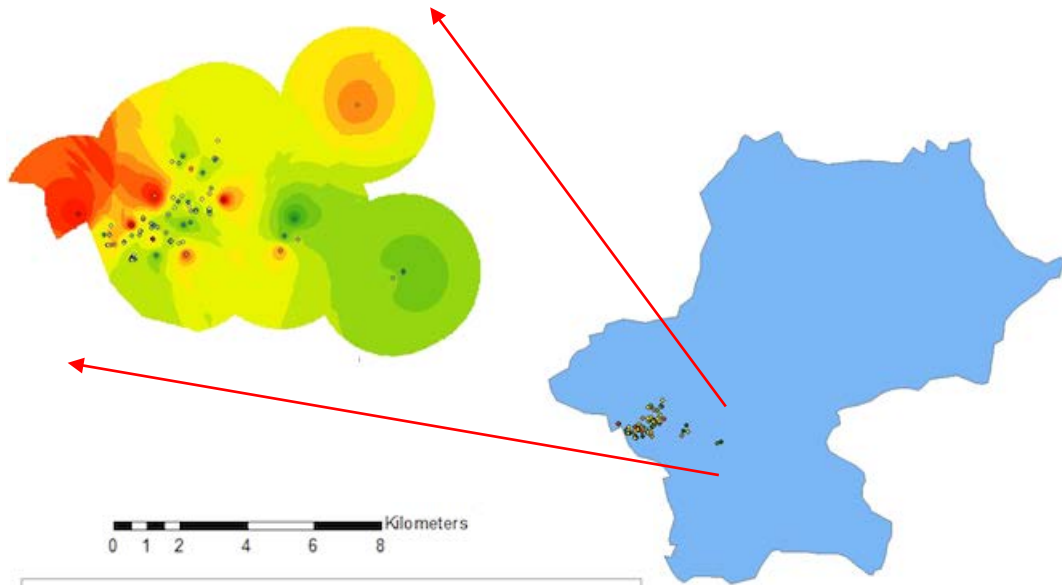


In geological terms, the plateau of Huila presents **granite** formations.

Large amount of magmatic rocks containing uranium and thorium contribute to local radiation levels twenty times higher than background.

These radioactive elements are also present in groundwater sources.





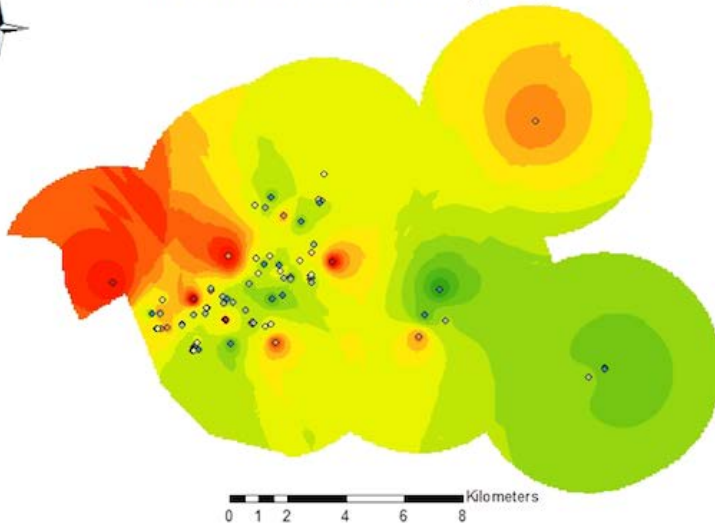
Radon concentrations in studied buildings: 30 to 415 Bq/m³.

Radon measurements in dwellings were carried out with nuclear track detectors CR-39 in the one-storey public and residential buildings, typical of the studied area.

There is substantial heterogeneity in the distribution of the radon in the Lubango city.



Radon Evaluation in Lubango-Angola

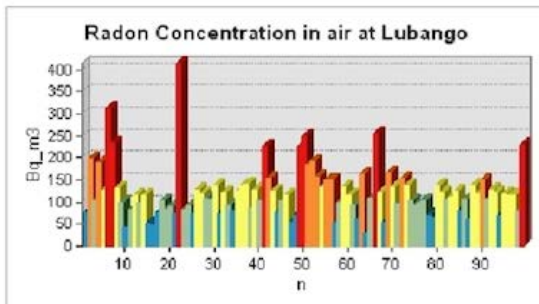


GPS
Bq/m³

- 30 - 80
- ◊ 81 - 109
- ◊ 110 - 140
- ◊ 141 - 198
- 199 - 415

<VALUE>

- 30,10381889 - 44,88304725
- 44,88304726 - 60,62991287
- 60,62991288 - 76,37677849
- 76,3767785 - 92,12364411
- 92,12364412 - 107,8705097
- 107,8705098 - 123,6173754
- 123,6173755 - 139,364241
- 139,3642411 - 155,1111066
- 155,1111067 - 170,8579722
- 170,8579723 - 186,6048378
- 186,6048379 - 202,3517035
- 202,3517036 - 251,7628174

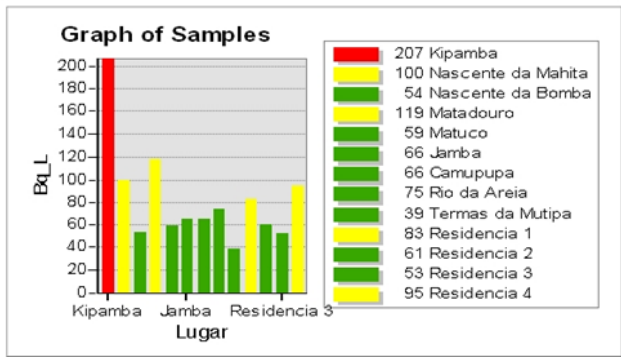
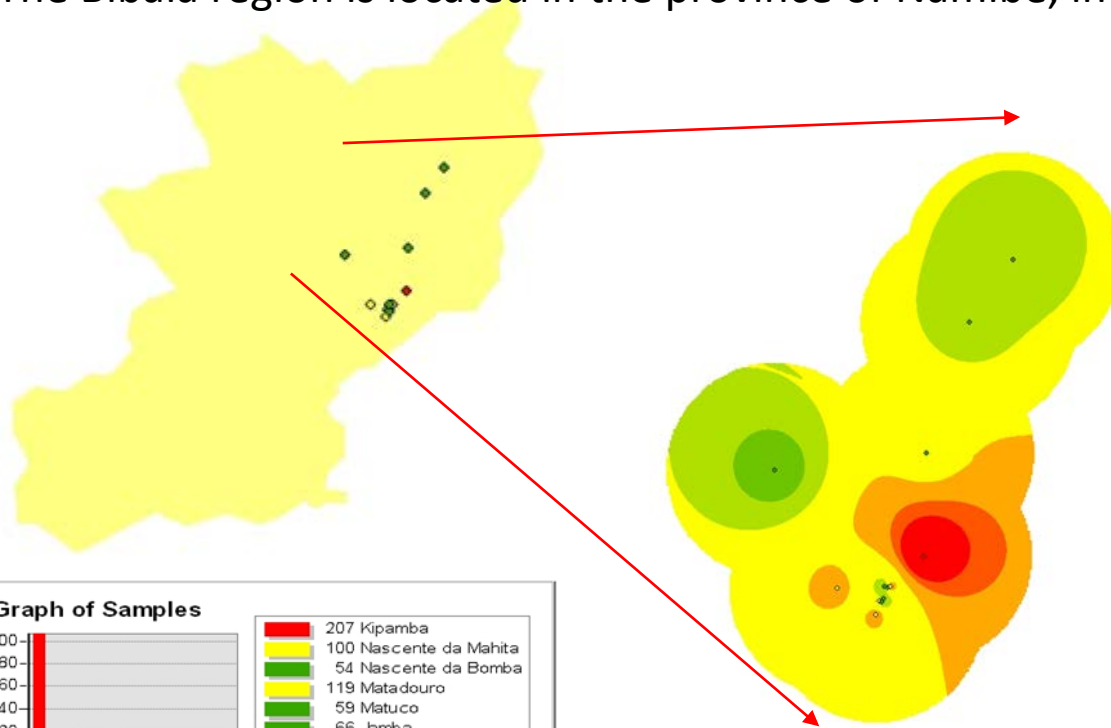


In the **east** and **central** region we got relatively low indoor radon levels, on average 30 Bq/m³.

In the **west** region radon concentration results are 13 times higher.

$30 > [Rn] > 100 \text{ Bq/m}^3$	36 %
$100 > [Rn] > 200 \text{ Bq/m}^3$	56 %
$[Rn] > 200 \text{ Bq/m}^3$	8 %

The Bibala region is located in the province of Namibe, in the Angolan southwest.

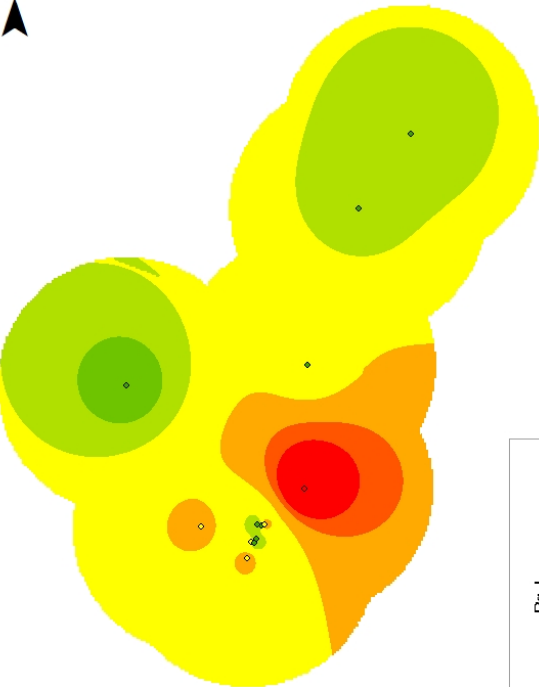


Radon concentrations in drinking water: 39 to 207 Bq/L

To determine the radon concentration in water samples, the RAD7 equipment, a radon monitor manufactured by the American company DurrIDGE, using the RAD7 H2O technique was used.



Radon evaluation in Bibala-Angola



Radon in water (Bq/l)

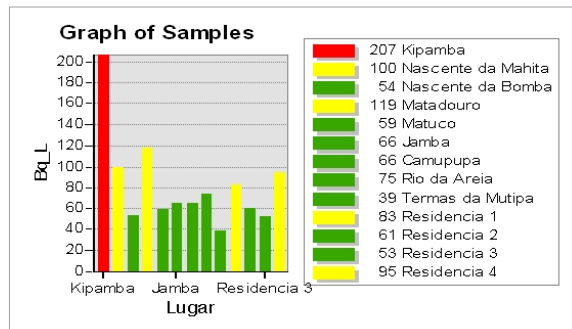
Samples

Bq_L

- ◆ 39 - 75
- ◇ 76 - 119
- ◆ 120 - 207

<VALUE>

- 39,00432587 - 39,09958736
- 39,09958737 - 55,06632429
- 55,0663243 - 71,03306121
- 71,03306122 - 86,99979814
- 86,99979815 - 102,9665351
- 102,9665352 - 118,933272
- 118,9332721 - 206,6763916



There is substantial heterogeneity in radon concentration in water samples of the Bibala region.

As we can see, results are higher in the **southeast** region.

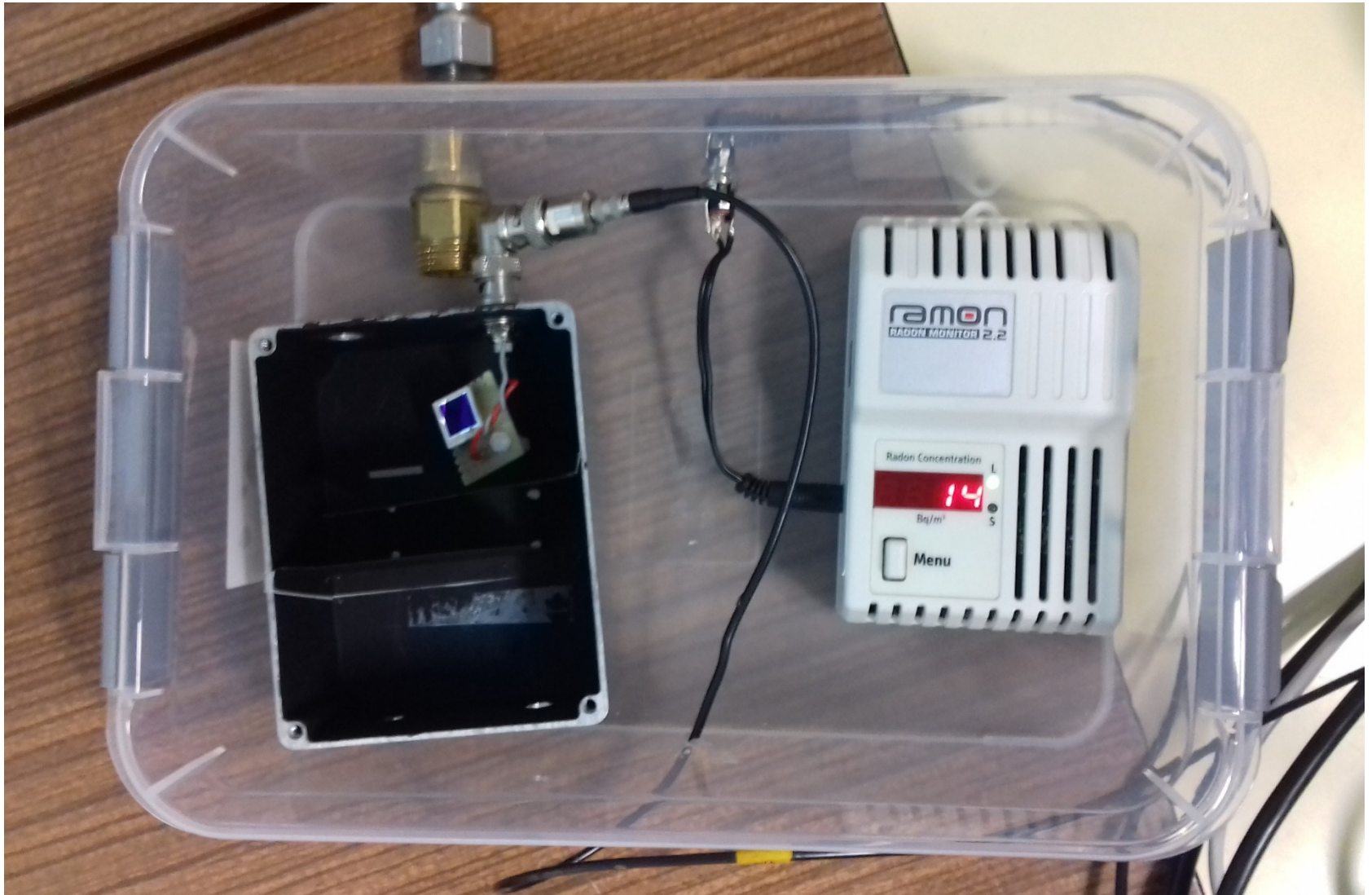
50 > [Rn] > 100 Bq/L	76 %
100 > [Rn] > 150 Bq/L	16 %
[Rn] > 150 Bq/L	8 %

The intended area to be covered is vast and Angolan laboratories do not yet have adequate equipment.

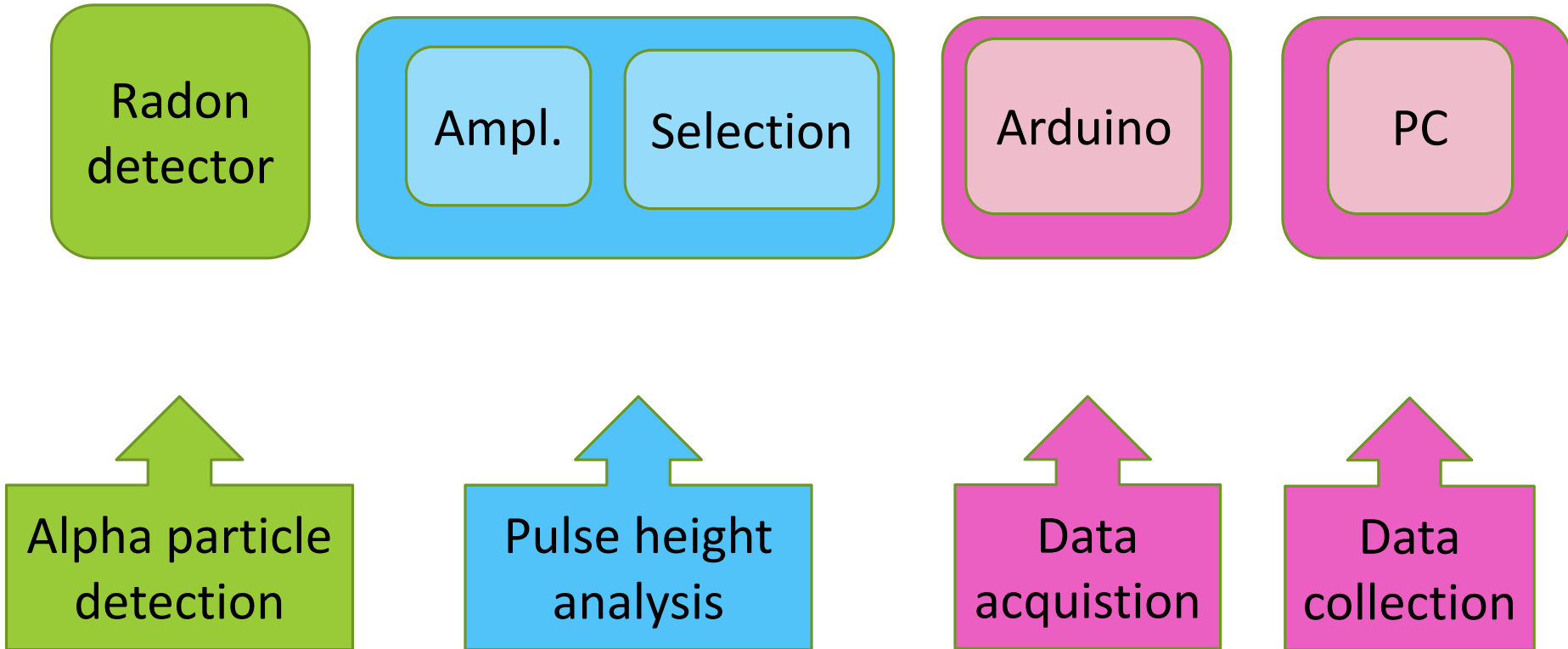
Methods based on low-cost monitors and detectors should be used.

So, to monitor radon, we intend to develop a low-cost radon monitoring system based on Si-PIN photodiodes.

Si-PIN and Radon monitor comparison



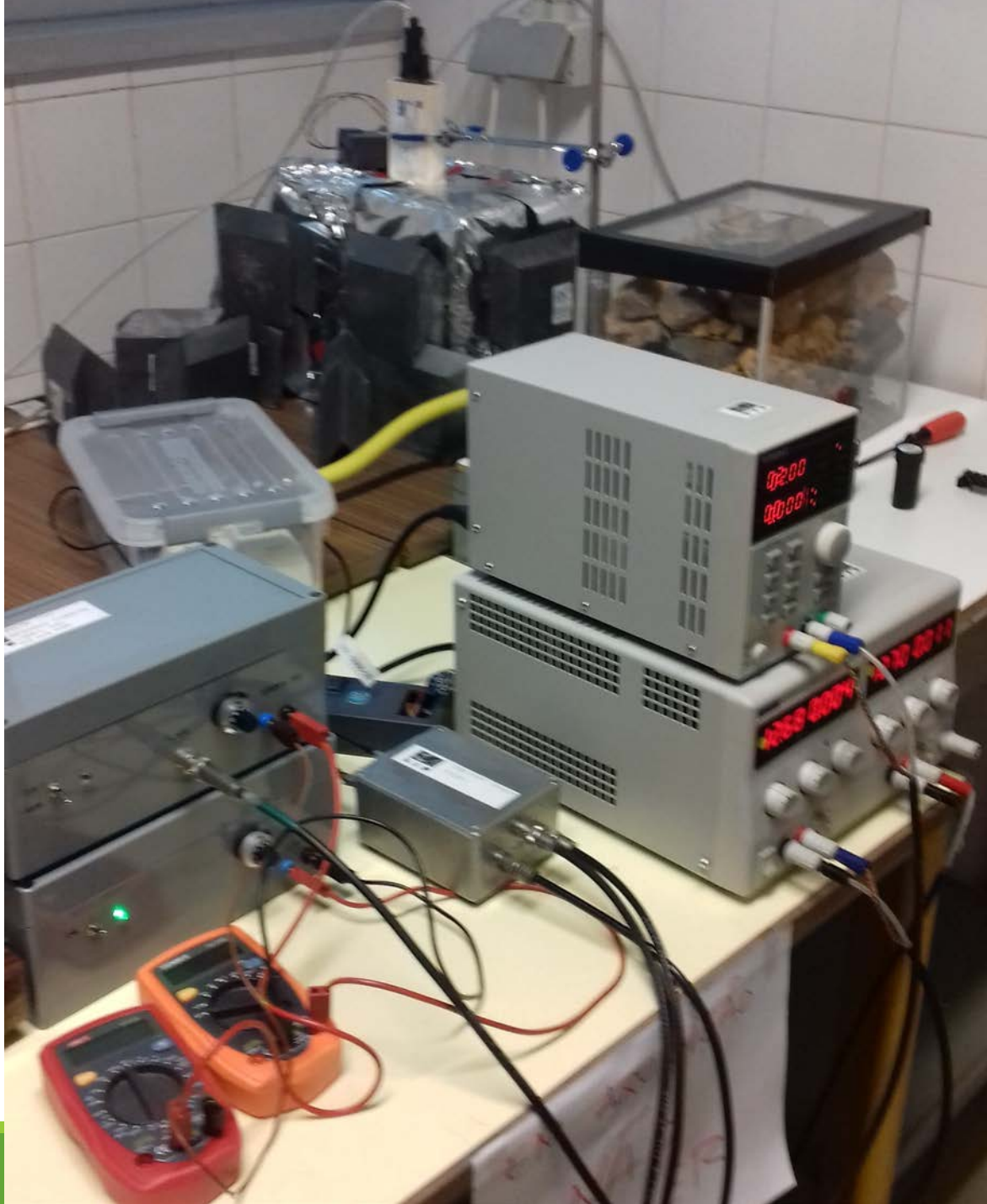
General radon detector design



Prototypes are tested using radon produced by rocks

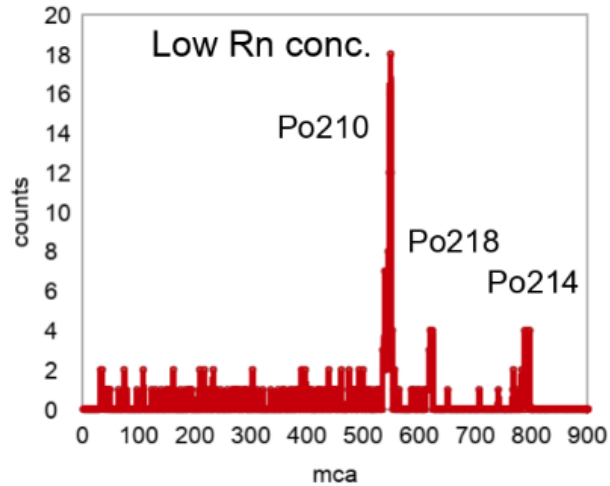




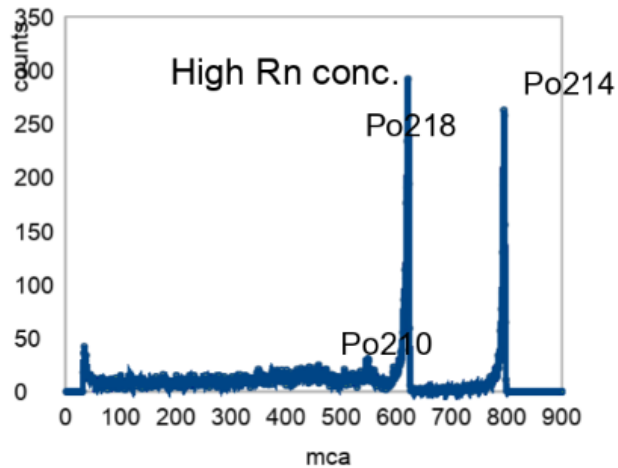


Energy spectra

Si-Pin detector



Usually what is detected is ^{214}Po and ^{218}Po , as the detector is contaminated also appears the peak of ^{210}Po .



Results from the ^{210}Pb remaining in the detector.

Preliminary conclusions

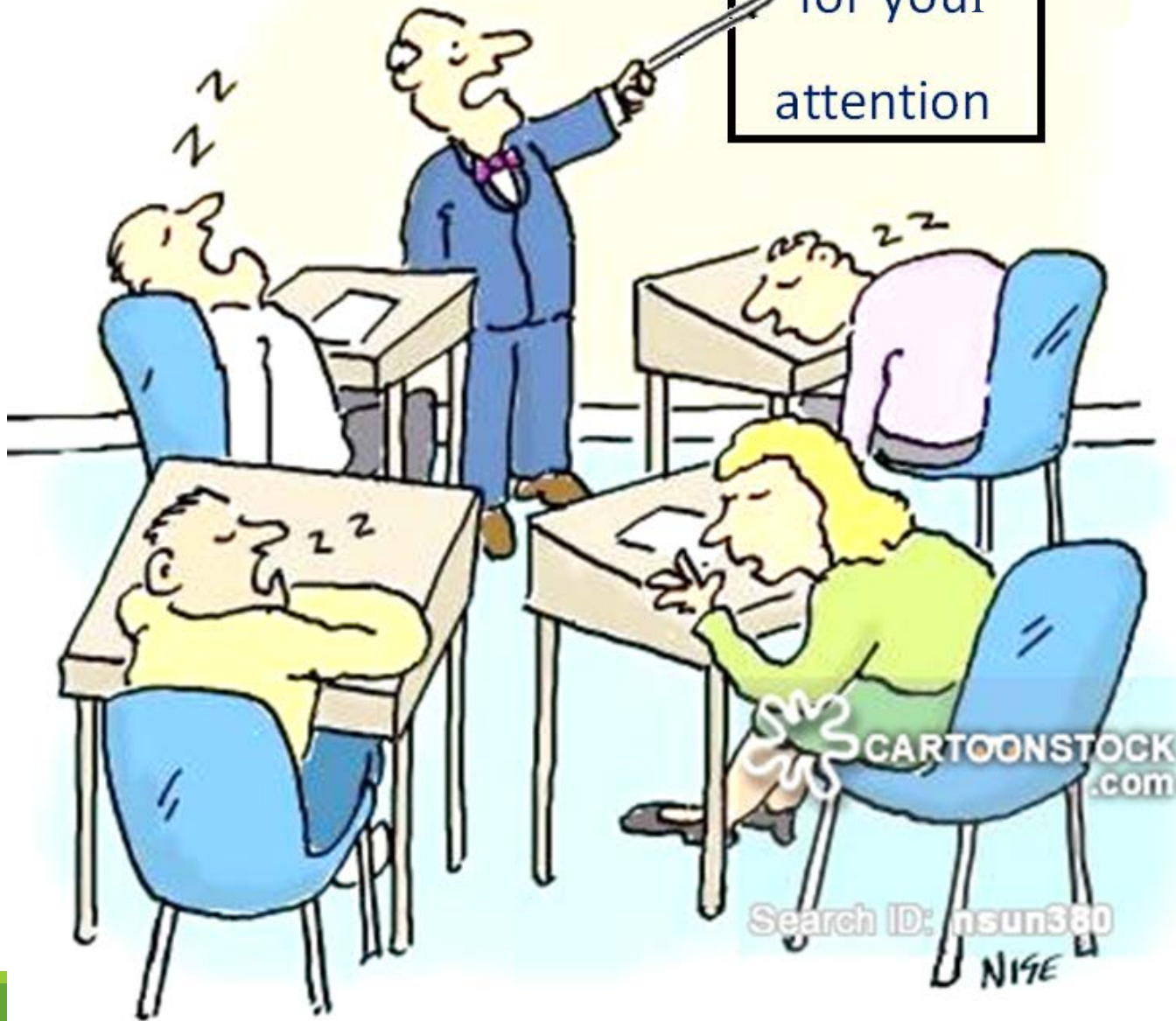
New measurements in air and water will be done.

Si-PIN is sensitive to alpha-particles “sticked” to its surface.

It's possible to make a radon detector based on Si-Pin as other authors have done before.

Future: several detectors in network monitoring selected sites.

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