A geological-based methodology for geogenic radon potential mapping: preliminary results in Portugal

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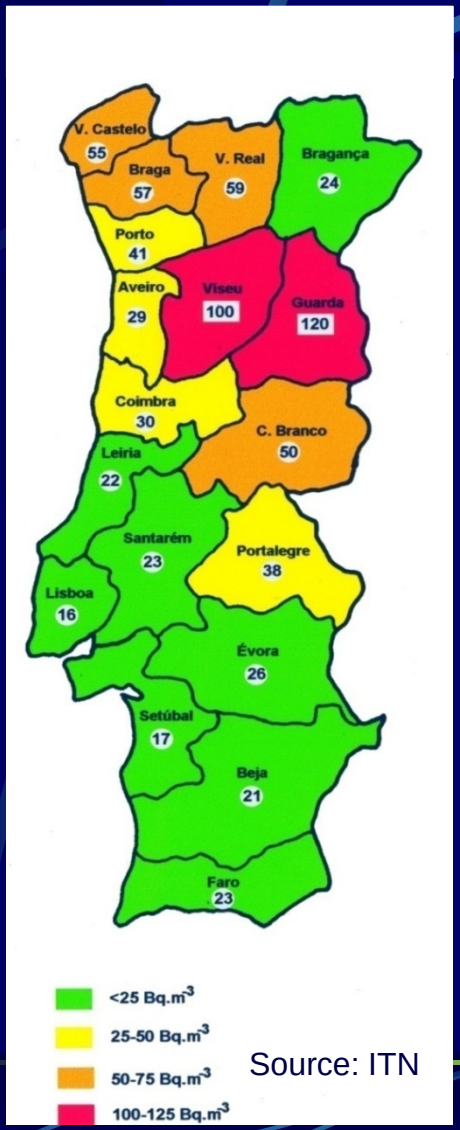
First indoor map (average radon concentrations by district)

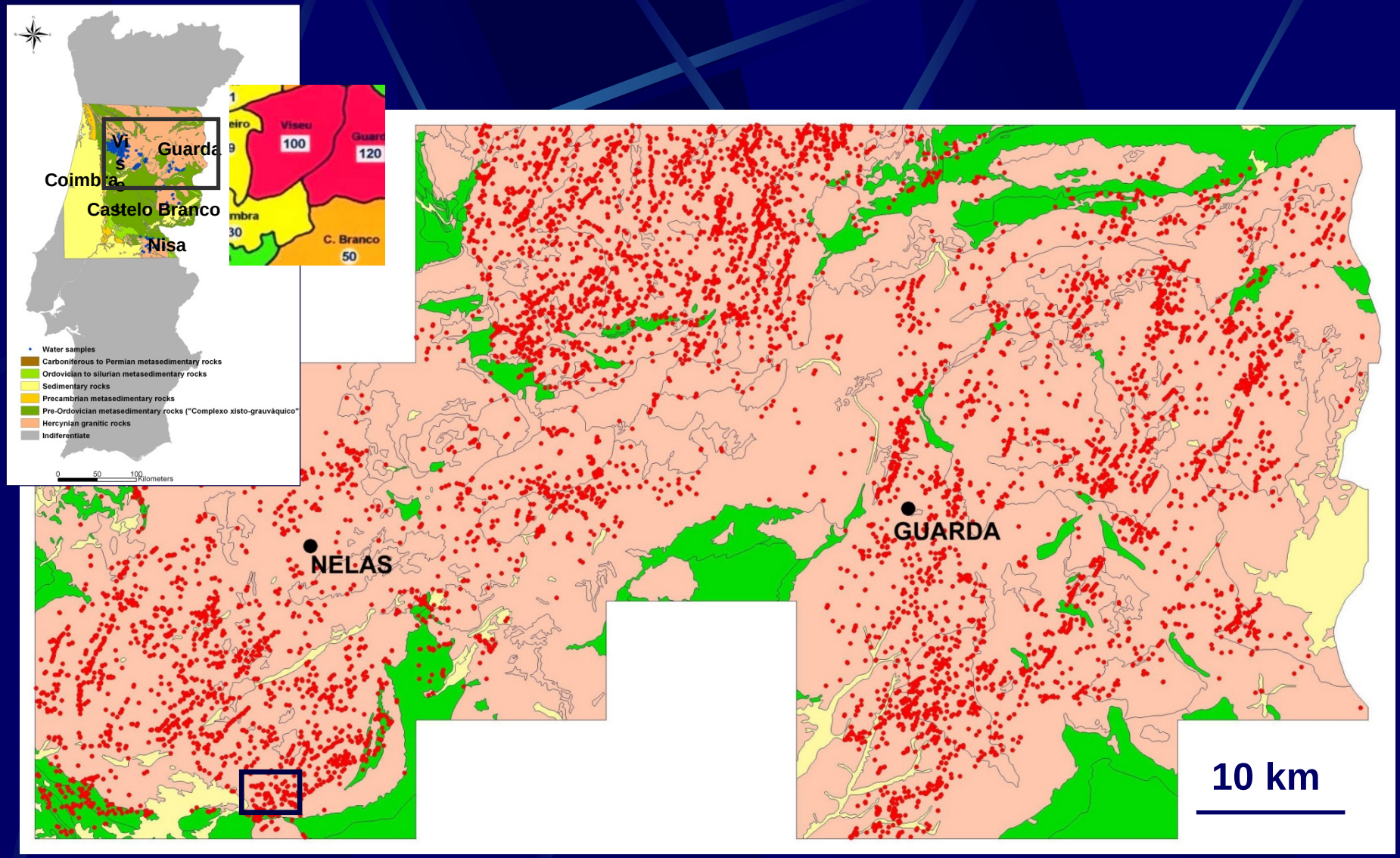


Source: ITN

At present, no geogenic potential radon map for the country

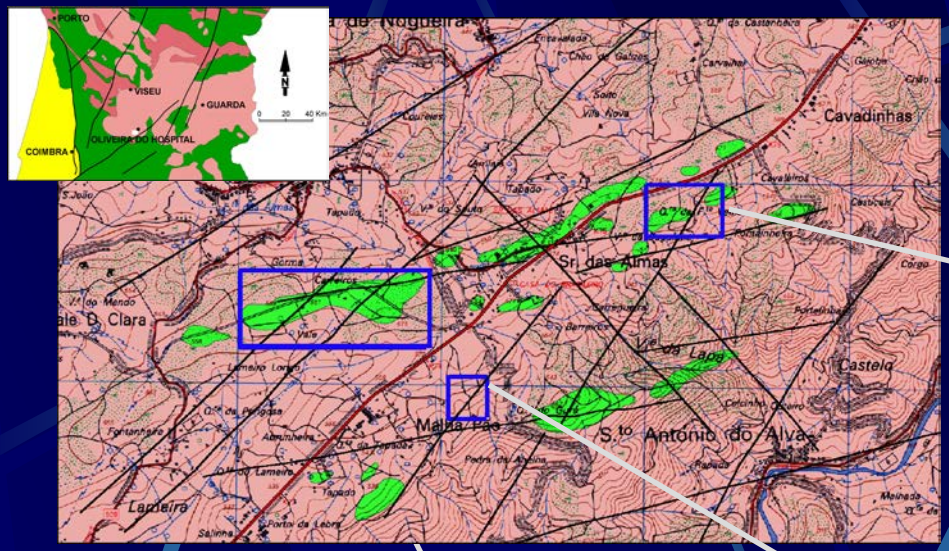
Nevertheless:

In the past gamma-ray surveys and soil gas radon data were used for large scale geogenic radon potential mapping (1: 5000). The purpose of these maps was for land use management of urban areas.

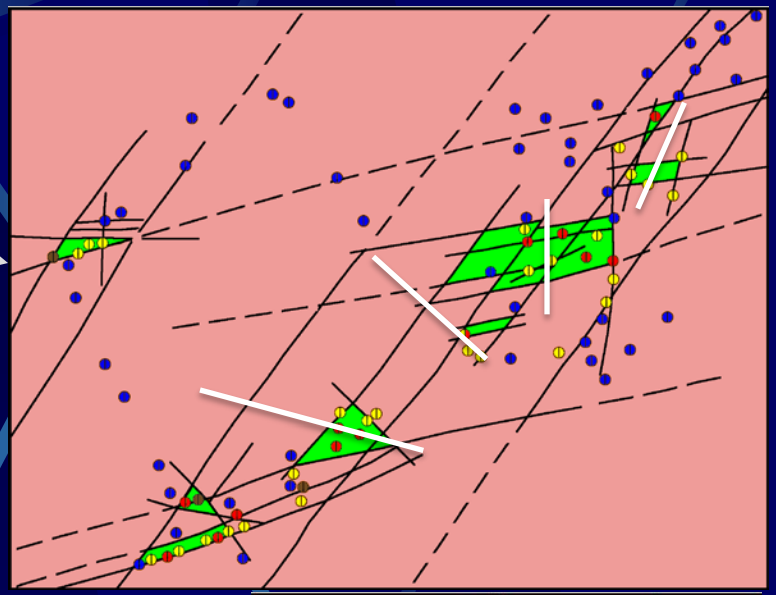


Gamma-ray anomalies, 2 to 50 times the background, over the geological map (1: 200 000)

Data from U prospecting works (1950 – 2000)



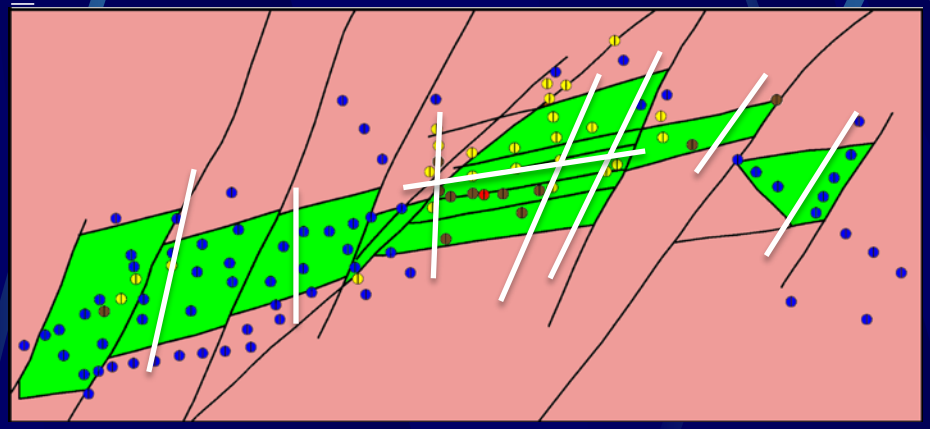
Scale 1:25 000

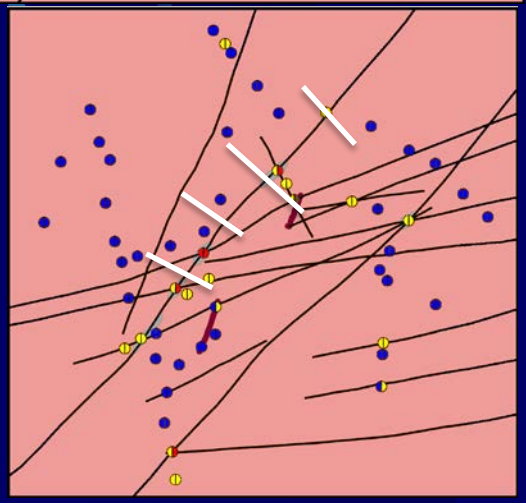


C

B

A

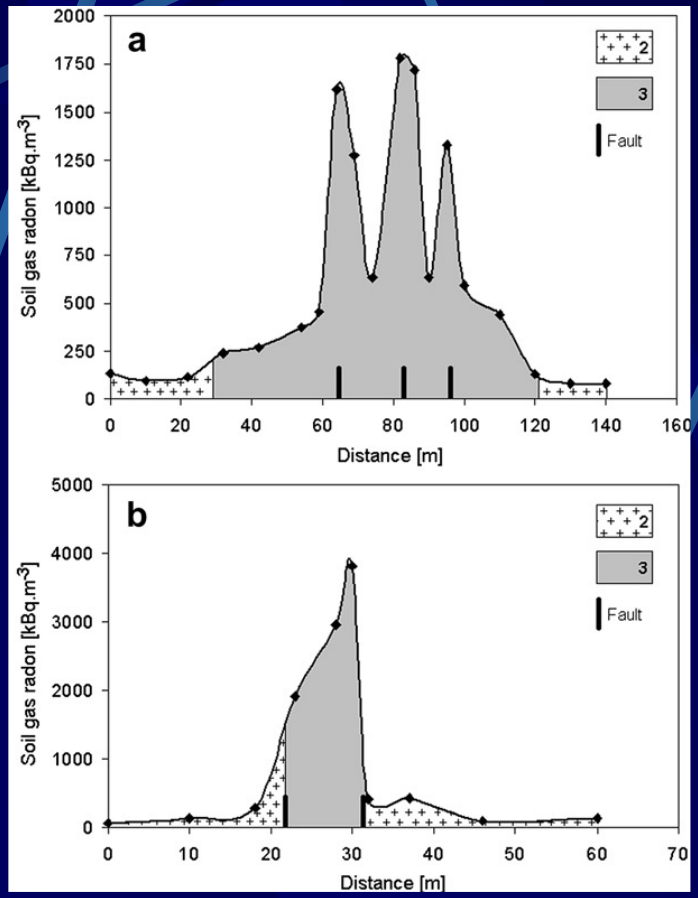


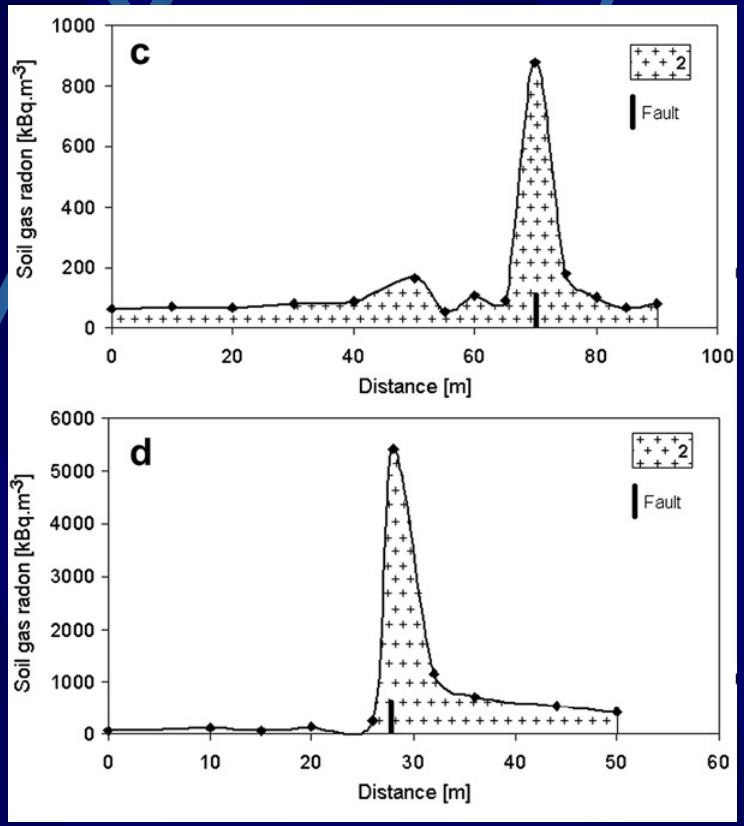


Scale 1: 5000

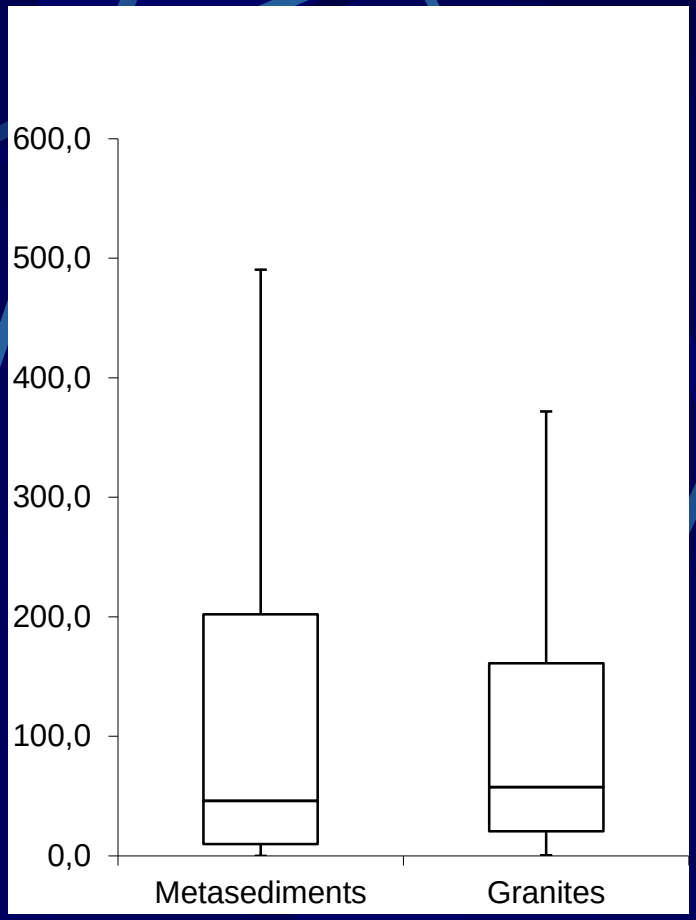
Transects for measurement of soil-gas radon concentrations
(distance between two consecutive points – 1 to 5 meters
color dots – gamma-ray data)

Soil-gas radon concentrations in different transcts – the role of U-enriched faults





Soil-gas radon activity concentrations – results in kBq/m^3)

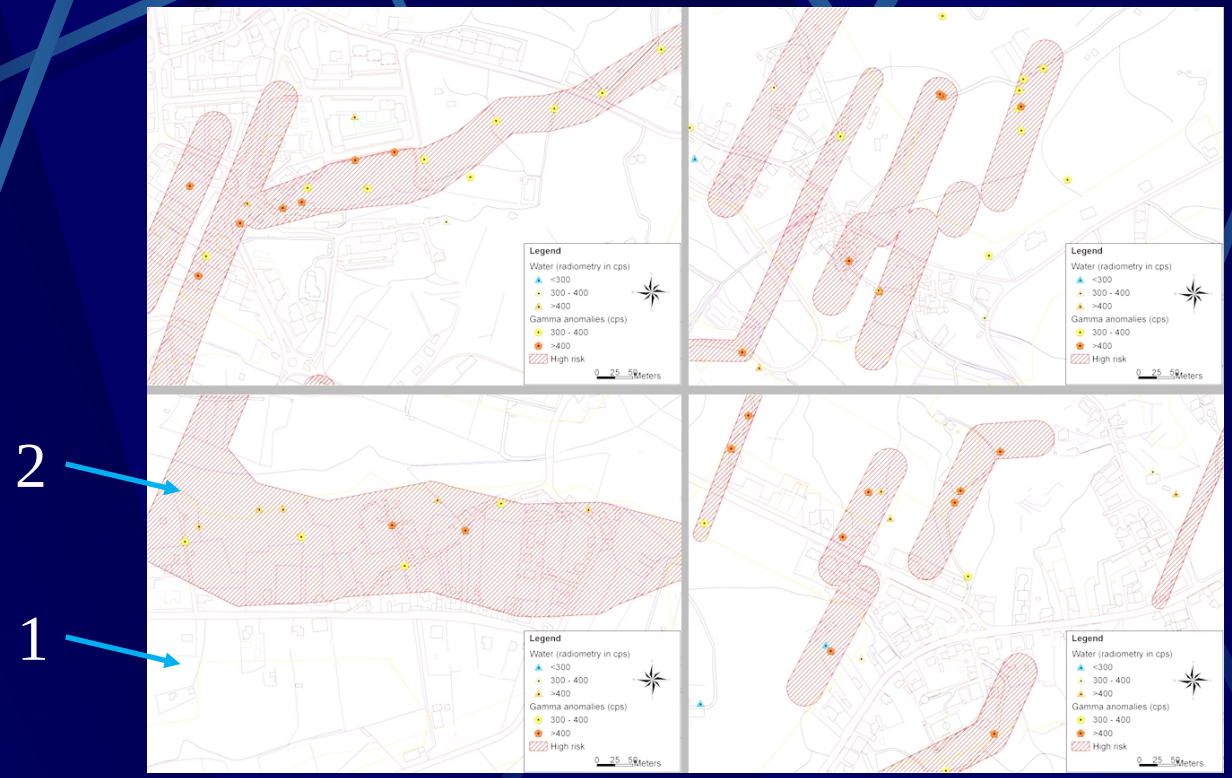


	Metasediments	Granites
Median	45.7	57.5
Q_3	202.2	161.0
Max	42 400.9	6 945.9
Upper Outliers	39	62
n	327	528

Total number of measurements = 885

Radon prone areas

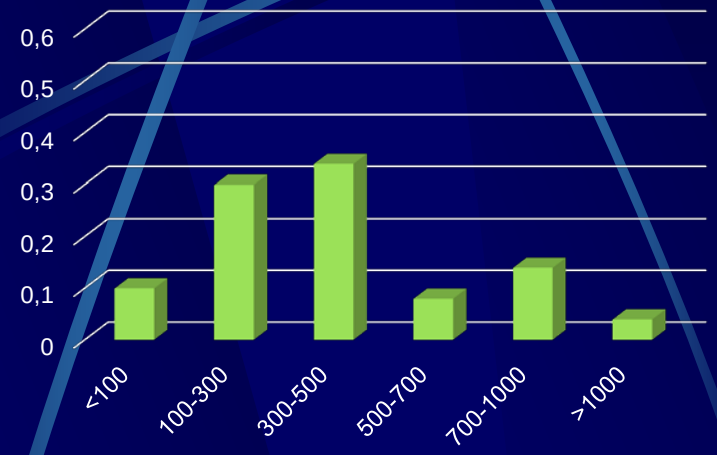
The geogenic radon potential map in an urban area from central Portugal



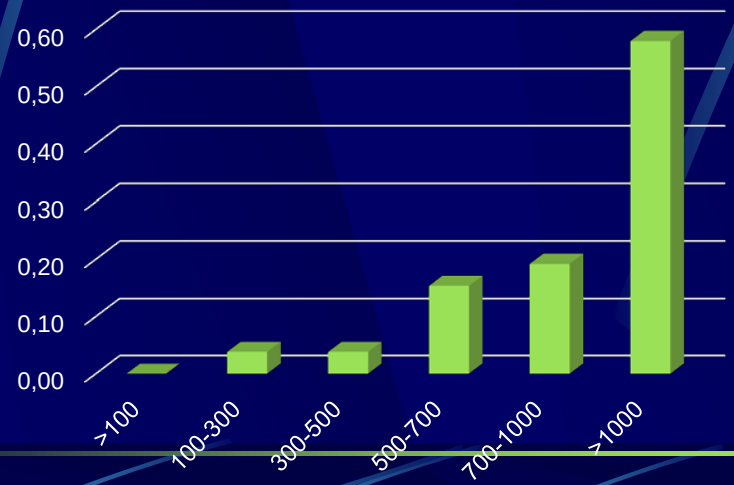
1 – Moderate to high 2 – High to very high 1: 5000

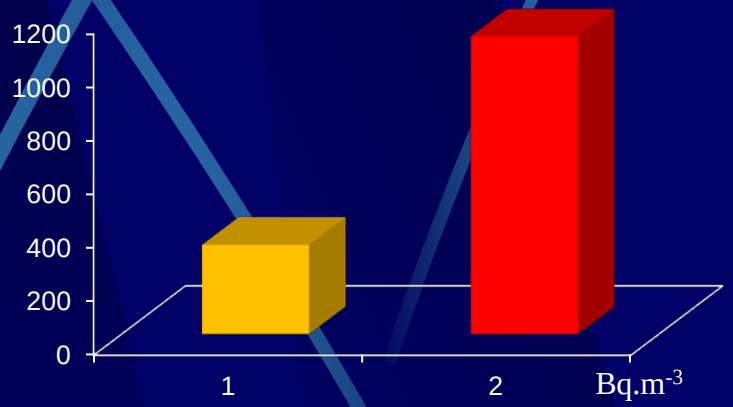
Indoor radon concentrations in dwellings of areas with variable geogenic radon potential (in Bq/m^3)

Moderate to high; n=50



High to very high; n=26

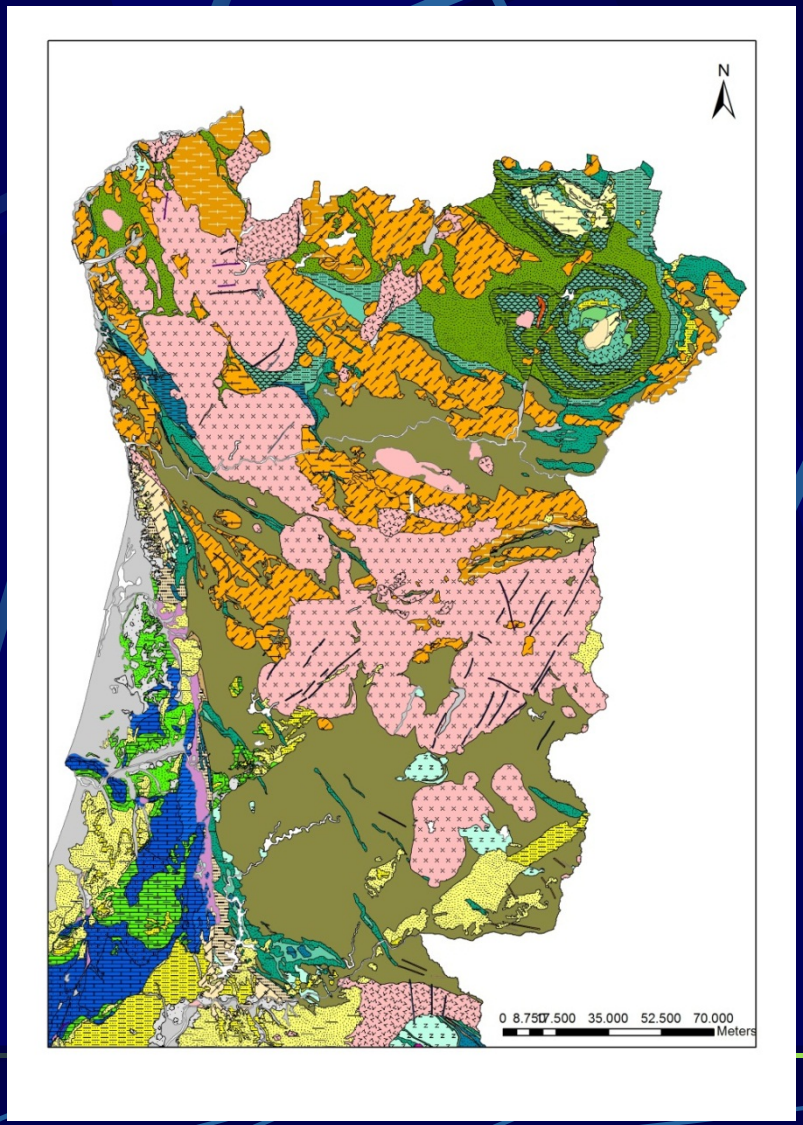


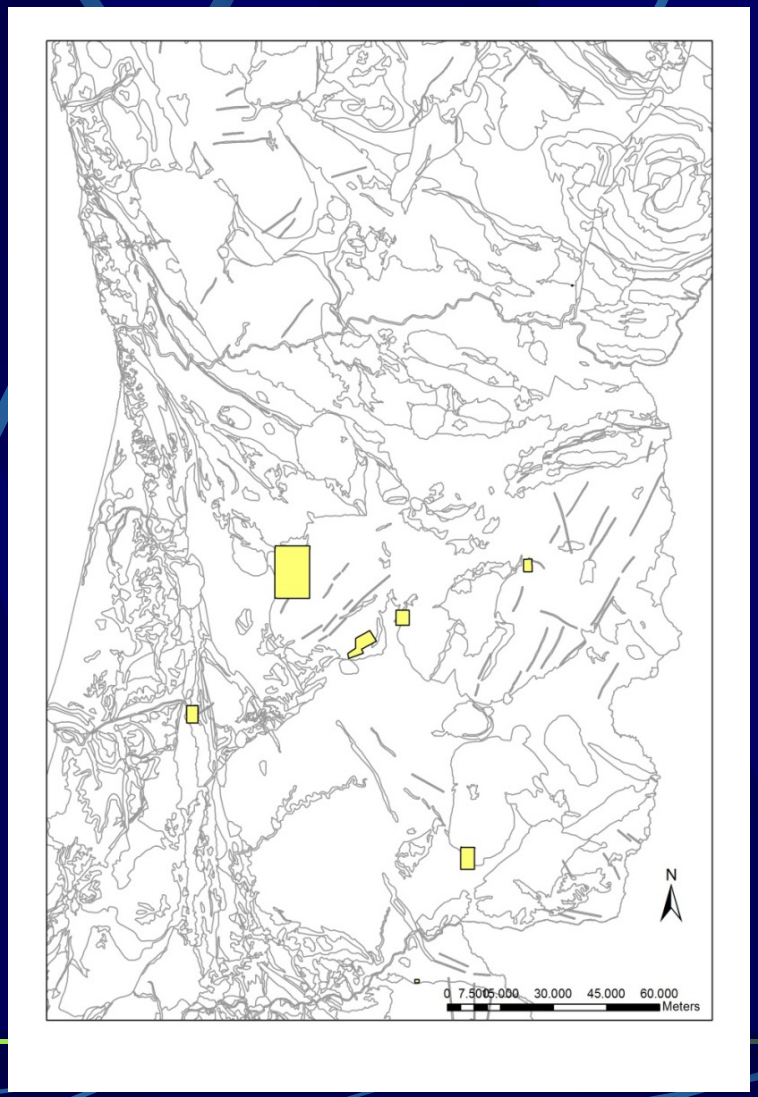


Indoor radon (median)

n = 76
Passive detectors CR-39

So, the soil-gas radon dataset in Portugal is restricted to a few areas of the central part of the territory …





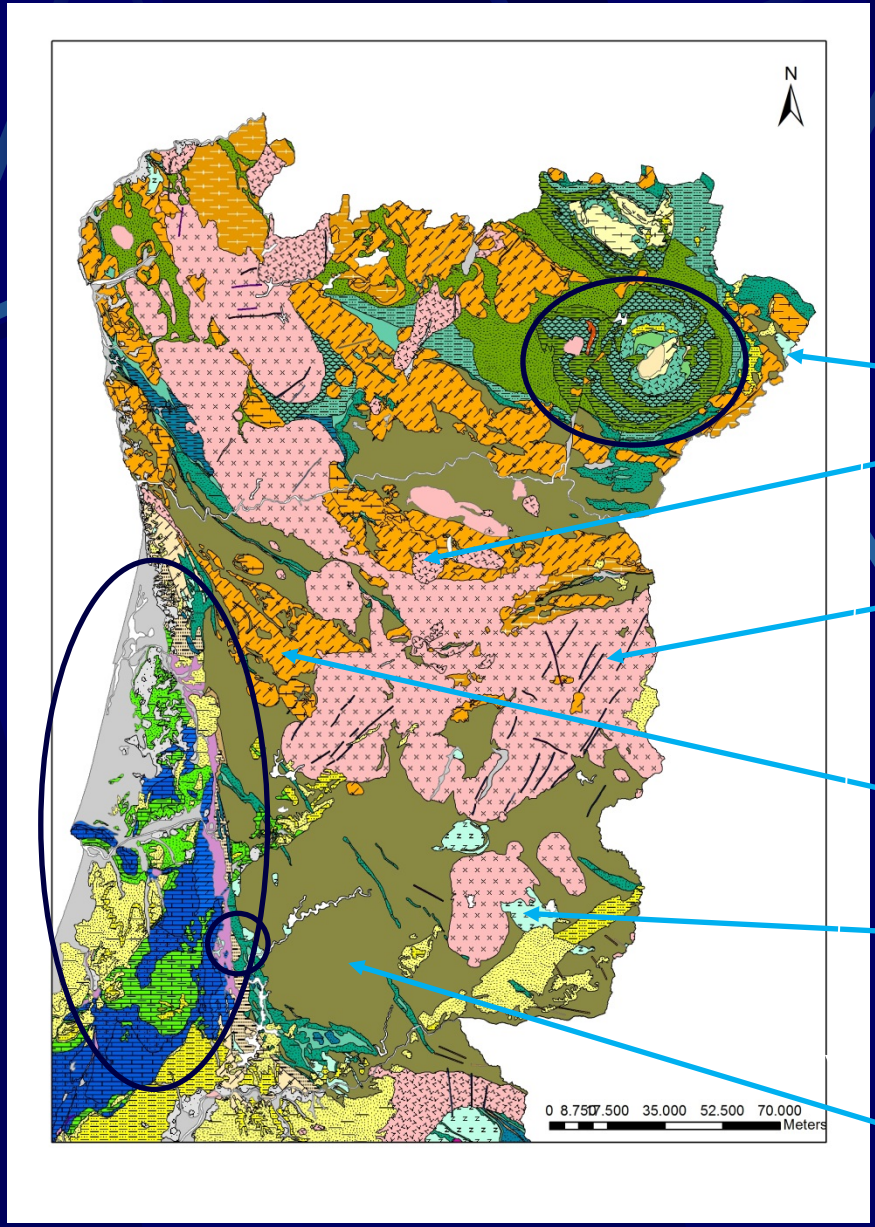
Problem:

How to draw a geogenic potential radon map of the whole country in face of the strong heterogeneity of the available dataset ?

The scarcity of soil-gas radon data in most part of the territory prevented the use of methods based on a statistical approach.

Therefore, a proper methodology must be set up to allow a quick and inexpensive way of getting the required information.

This could be achieved by combining geological data with radon gas data sources – the base is the geological unit



Paleozoic metasediments

Post-tectonic granites

Hercynian porphyritic biotite granites

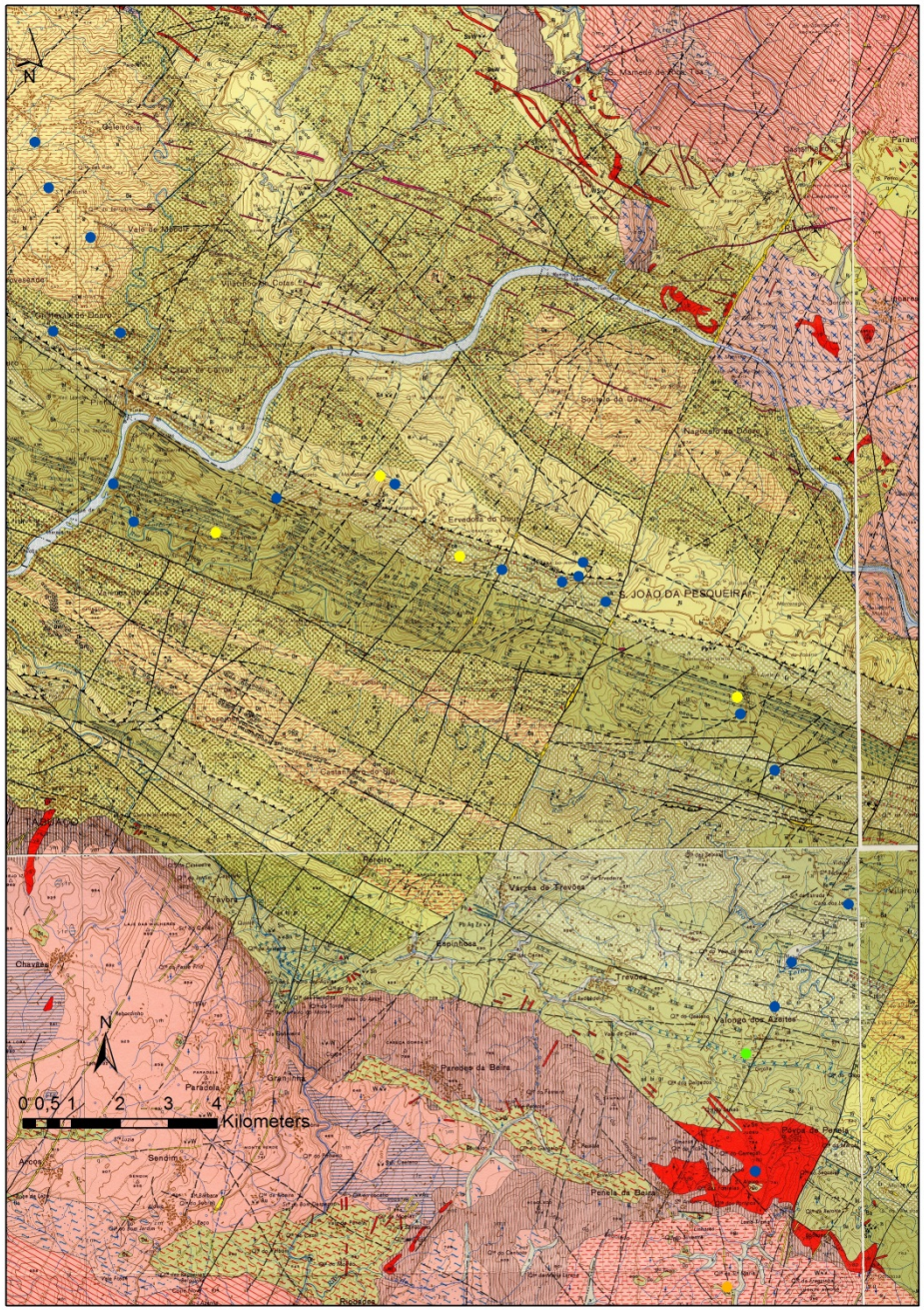
Hercynian two mica granites

Pre-hercynian granites

Pre-ordovician metasediments

Post mesozoic sediments

Base: the geological data included in the project OneGeology, with some adjustments

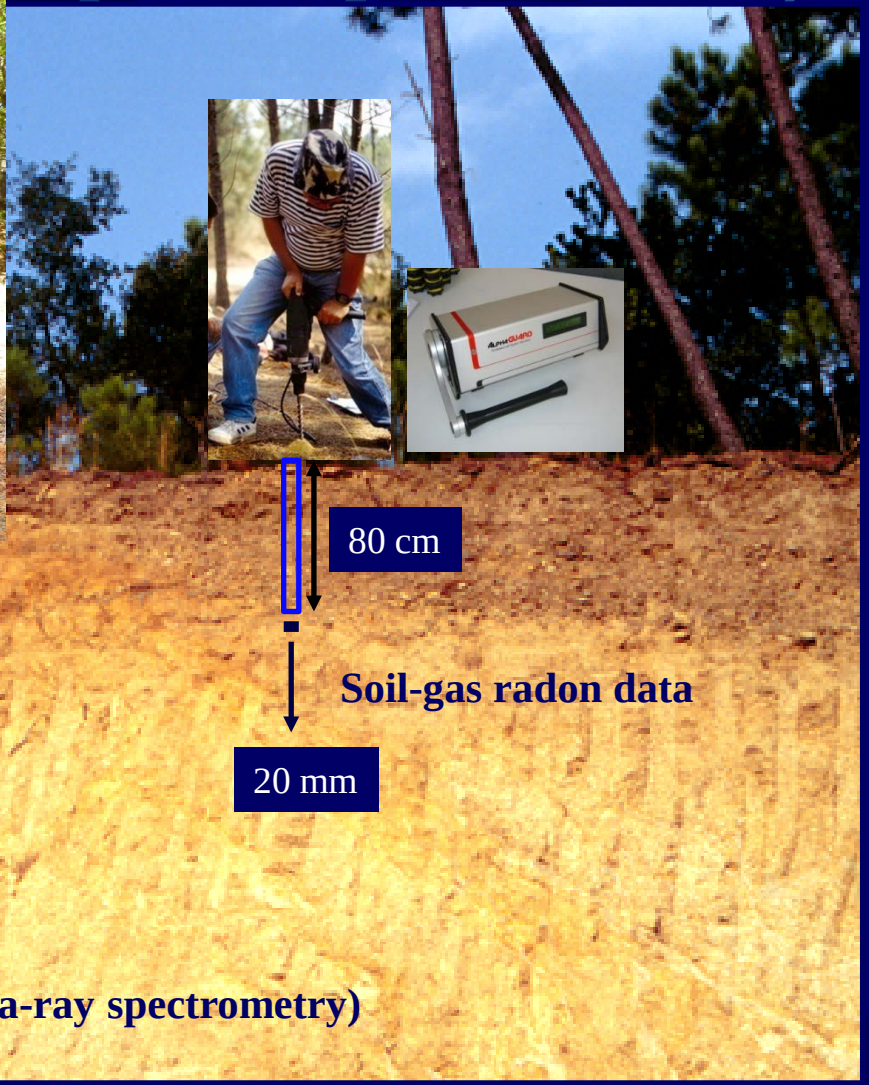


Baseline is the 1: 500 000 scale geological map - transects to the geological structures

but sampling is also controlled by data provided by larger scale geological maps (1: 50 000)

A GIS project, integrated with mobile devices, helps to manage the research work

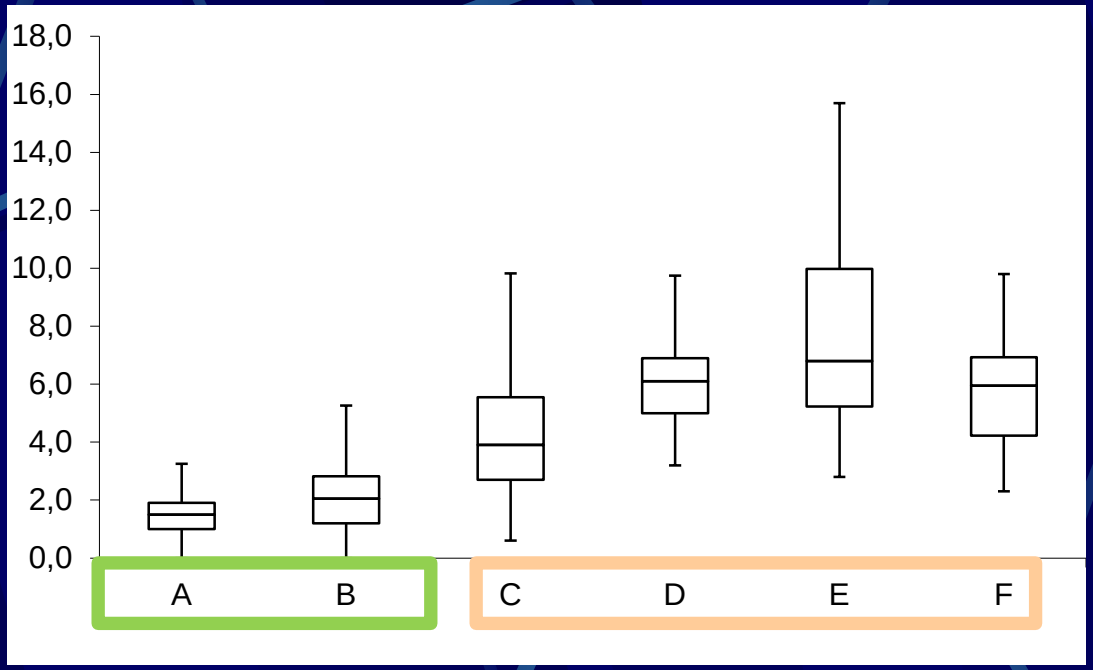
Data acquistion



KUTh data (gamma-ray spectrometry)

"Soils" in the portuguese territory are in most part only altered rock with variable tickness

Uranium content (ppm) in selected samples (gamma spectrometry)

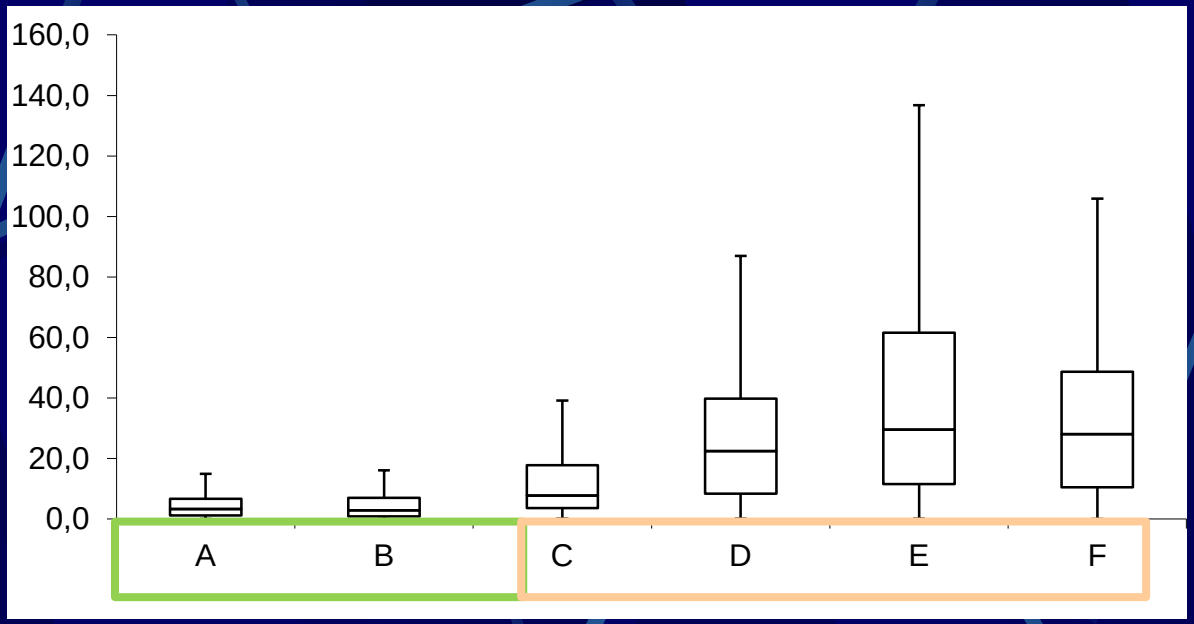


n=250, at present

A – Pre-ordovician metasediments; B – Paleozoic metasediments; C – Pre-hercynian granites; D – Hercynian two-mica granites; E – Hercynian porphyritic biotite granites; F – Post-tectonic granites

	A	B	C	D	E	F
Median	1.5	2.1	3.9	6.1	6.8	6.0
Q_3	1.9	2.8	5.6	6.9	10.0	6.9
Max	5.2	49.2	12.9	11.2	15.7	9.8
Upper Outliers	4	2	2	1	0	0

Soil-gas radon concentrations (kBq/m^3)

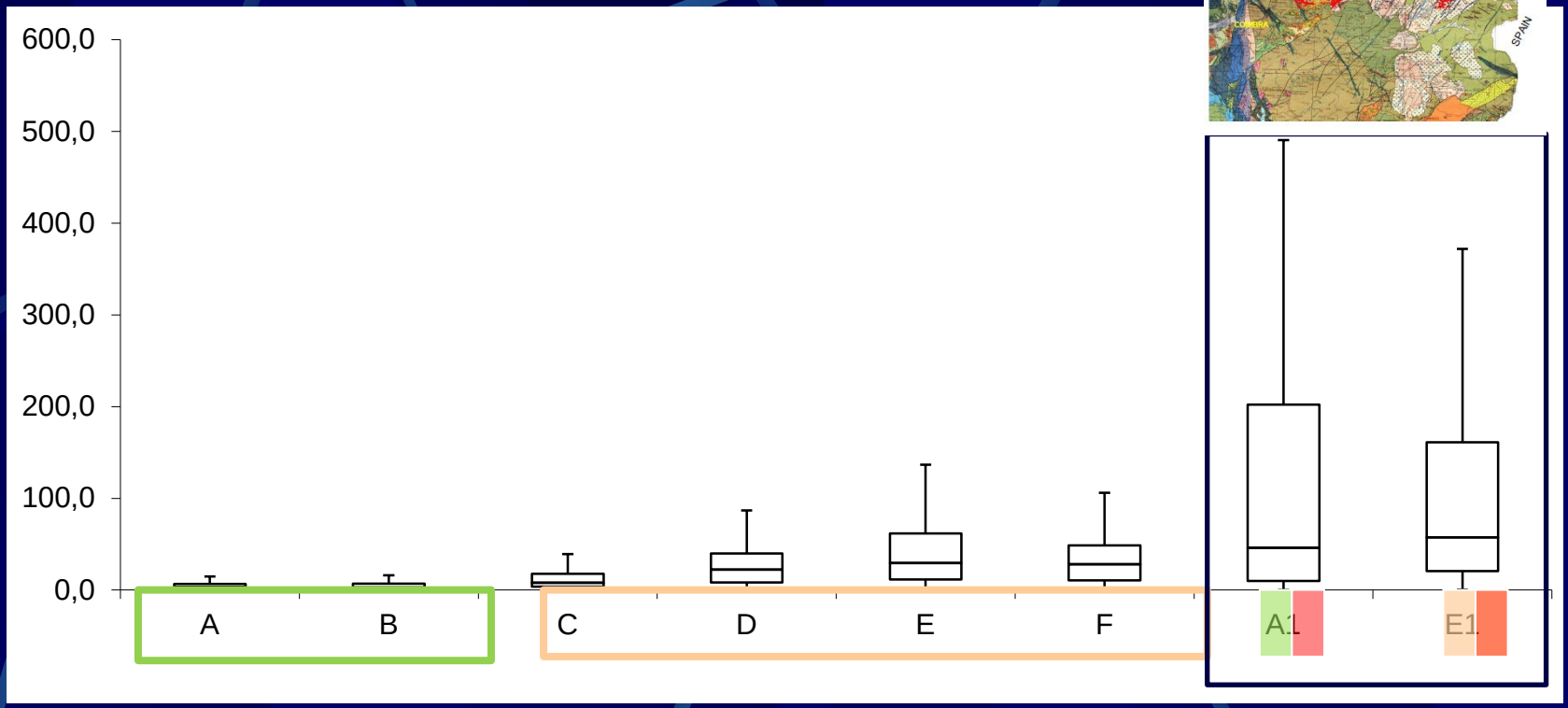


A – Pre-ordovician metasediments; B – Paleozoic metasediments; C – Pre-hercynian granites; D – Hercynian two-mica granites; E – Hercynian porphyritic biotite granites; F – Post-tectonic granites

	A	B	C	D	E	F
Median	3.3	2.9	7.8	21.1	29.6	28.1
Q_3	6.7	7.0	17.8	38.1	61.6	48.7
Max	80.2	206.4	315.3	522.4	664.7	386.6
Upper Outliers	13	14	7	14	22	7
n	111	133	79	175	239	89

Total number of measurements = 826, at present

Soil-gas radon concentrations (kBq/m^3)

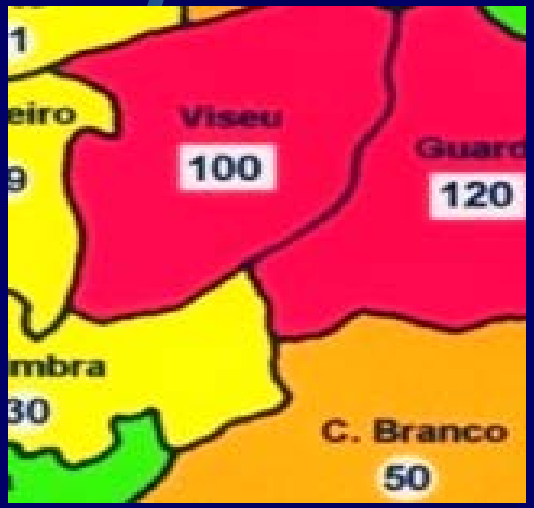


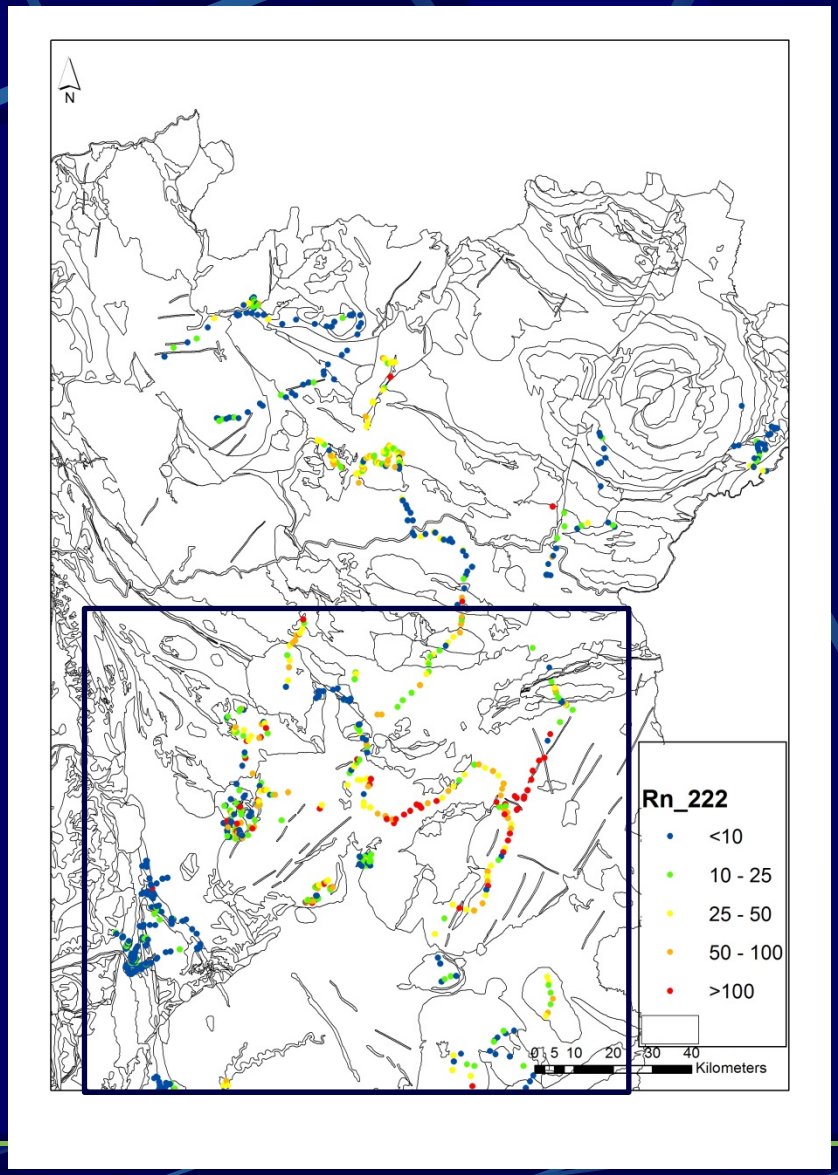
Radon-prone areas

	A	B	C	D	E	F	A1	E1
Median	3.3	2.9	7.8	21.1	29.6	28.1	45.7	57.5
Q_3	6.7	7.0	17.8	38.1	61.6	48.7	202.2	161.1
Max	80.2	206.4	315.3	522.4	664.7	386.6	42 400.9	6 945.9
Upper Outliers	13	14	7	14	22	7	39	62

Spatial distribution of soil-gas radon concentrations (in kBq/m^3)

Indoor radon
(average by district)





Total nº of measurements close to 2000 (at present)

The research on radon in the portuguese territory allowed to draw the following conclusions:

a) Correlation between lithology, U content in rocks and soil-gas radon concentrations, with detection of the radon-prone areas.

b) Correlation between soil-gas and indoor radon concentrations allowed to build small scale geogenic prognosis maps.

c) Partial correlation between gamma-ray dose rate and soil-gas concentrations

d) However, as is not possible to control all the factors involved (e.g. foundations, building materials, ventilation rate) the need of local measurements (soil-gas and indoor radon) can´t be discarded

Thanks/dekuji