

# **Latest news about radon Mapping in Spain**

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Professor University of Cantabria

**Radon Group, University of Cantabria**

**11<sup>th</sup> INTERNATIONAL WORKSHOP ON THE GEOLOGICAL ASPECTS  
OF RADON RISK MAPPING**  
September 18th-20th, June 2012  
Prague, Czech Republic



**COACH**



José - Luis Arteché García

**BENCH**



Santiago Celaya

## **Radon Group**

### **35 YEARS DEALING WITH NATURAL RADIATION**

**.- 15000 RADON MEASUREMENTS**

**.-9000 SOIL SAMPLES ANALYSIS**

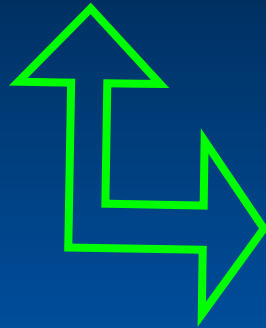
**.- 7000 EXTERNAL GAMMA RADIATION MEASUREMENTS**





# HEALTH RISKS

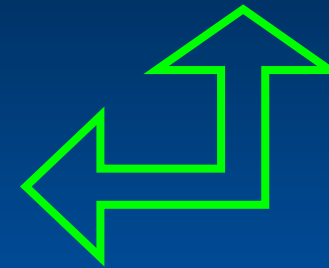
**Epidemiological  
Approach**



**Factor 1-3**



**Dosimetric  
Approach**



***RADON AND PROGENY WILL BE TREATED  
IN THE SAME WAY AS OTHER RADIONUCLIDE  
ICRP, Publication 115 (2010)***



**International Commission on Radiological Protection**

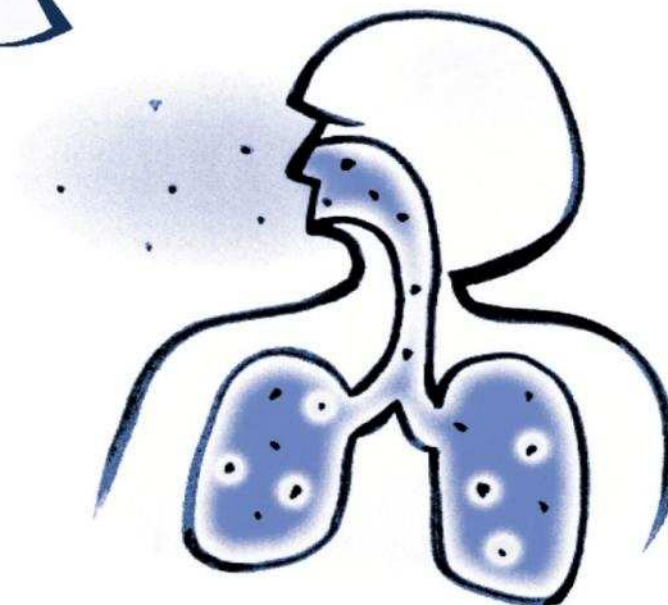
# **Statement on Radon**

**Approved by the Commission in Porto on November  
2009**

# EPIDEMIOLOGICAL

## WHO HANDBOOK ON INDOOR RADON

A PUBLIC HEALTH PERSPECTIVE



World Health  
Organization

Windows taskbar: Inicio, Quindos Poncela, Luis..., praga2012.ppt - Ope..., India2012\_V1.0.ppt - ..., Harrison-AnnICRP-xx..., Escritorio, ES, 0:01, domingo, 09/09/2012.

Adobe Reader window: Harrison-AnnICRP-xx-2012.pdf - Adobe Reader

Menu: Archivo, Edición, Ver, Documento, Herramientas, Ventana, Ayuda

Toolbar: 1 / 11, 106%, Buscar

Left sidebar: Marcadores

- Effective dose from inhaled radon and its progeny
  - 1 Introduction
  - 2 Radon dosimetry
    - 2.1 Reference aerosol parameter values
      - 2.1.1 Indoor workplaces
      - 2.1.2 Mines
    - 2.2 Preliminary results
  - 3 Dose conversion convention
  - 4 Discussion
  - 5 Conclusion
  - References

Article content:

ARTICLE IN PRESS

ELSEVIER

ICRP  
Annals of the ICRP

## Effective dose from inhaled radon and its progeny

J.D. Harrison, J.W. Marsh

*Health Protection Agency, Centre for Radiation, Chemical and Environmental Hazards, Chilton, Didcot, Oxon OX11 0RQ, UK; e-mail: john.harrison@hpa.org.uk*

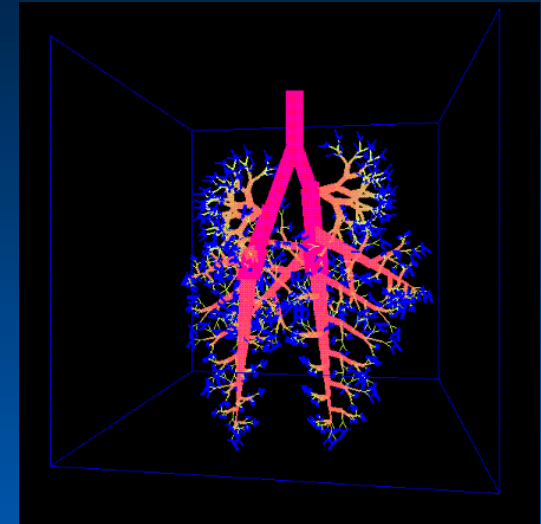
**Abstract**—Currently, the International Commission on Radiological Protection (ICRP) uses the dose conversion convention to calculate effective dose per unit exposure to radon and its progeny. In a recent statement, ICRP indicated the intention that, in future, the same approach will be applied to intakes of radon and its progeny as is applied to all other radionuclides, calculating effective dose using reference biokinetic and dosimetric models, and radiation and tissue weighting factors. Effective dose coefficients will be given for reference conditions of exposure. In this paper, preliminary results of dose calculations for Rn-222 prog-

# Risk assessment

## Dosimetric model

### Estimation of dose per unit exposure from respiratory tract model

- Progeny retention period
- Weighting factor for alpha particles
- Sensibility of pulmonary tissue
- Weighting factors for each region
- Probability density function



Applied to miner's conditions (Birchall 1994) 15 mSv WLM<sup>-1</sup>

Applied to dwellings (Marsh 2002) 12 mSv WLM<sup>-1</sup>

**Table 2.** Average dose conversion factor ( $DCF$ ) for the inhalation of unattached ( $DCF_u$ ) and aerosol attached ( $DCF_{ae}$ ) radon decay products in air of human living places arranged accordingly to aerosol conditions, relative cancer sensitivity distribution of the bronchial ( $w_{BB}$ ), bronchiolar ( $w_{bb}$ ) and alveolar ( $w_{AI}$ ) regions of the thoracic lung,  $v$  = inhalation rate,  $Z$  = particle concentration of the aerosol.

Place	Particle concentration $Z$ ( $10^3 \text{ cm}^{-3}$ )	Nose breathing $v$ ( $\text{m}^3 \text{ h}^{-1}$ )	$DCF$ ( $\text{mSv WLM}^{-1}$ ) ( $DCF_u + DCF_{ae}$ )	
			$w_{BB} = w_{bb} = w_{AI} = 0.33$	$w_{BB}:w_{bb}:w_{AI} = 0.8:0.15:0.05$
Outdoor air	20–40	1.2	13.2 (0.6 + 12.6)	9.7 (1.5 + 8.2)
Dwellings	5–40	0.75	8.3 (1.0 + 7.3)	7.3 (2.4 + 4.9)
	40–500	0.75	6.1 (0.1 + 6.0)	4.2 (0.2 + 4.0)
Working places	1–10	1.2	12.0 (3.0 + 9.0)	13.0 (7.0 + 6.0)
	10–50	1.2	8.6 (0.6 + 8.0)	6.7 (1.5 + 5.2)
	50–500	1.2	8.2 (0.2 + 8.0)	5.7 (0.5 + 5.2)
	50–500	1.7	10.3 (0.3 + 10.0)	7.2 (0.7 + 6.5)

Ref: Reinniking-Porstendorfer, 1997.



# DOSE FROM RADON

**600 Bq/m<sup>3</sup> ----- 10 mSv/year**

**T=7000 h F= 0.4**

ICRP65



**300 Bq/m<sup>3</sup>, ICRP 115**



**18 mSv/year**

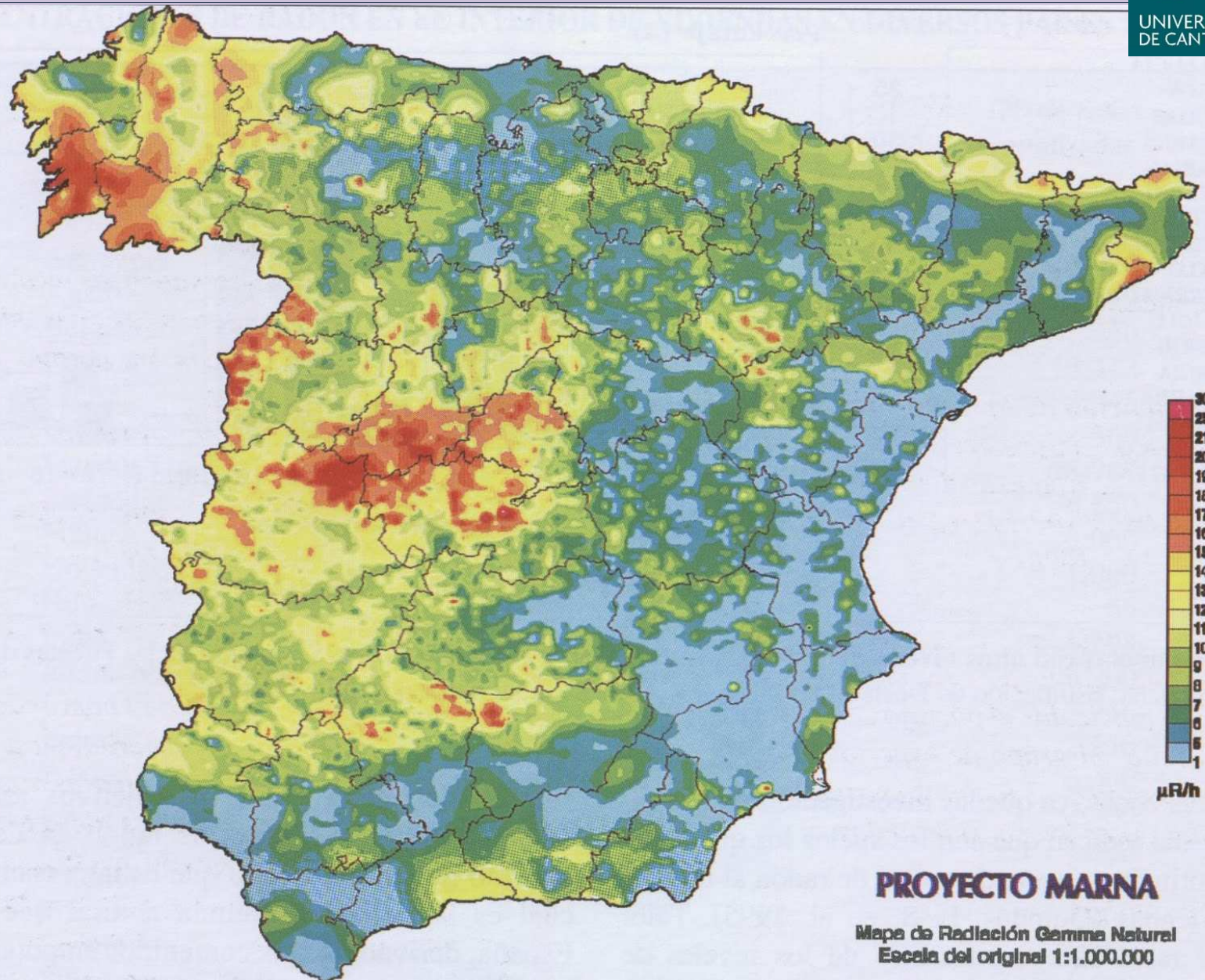


# European Council Directive 96/29 EURATOM

Reduction of dose limit: 50mSv/a --> 20 mSv/a  
Members of the public --> 1 mSv/a

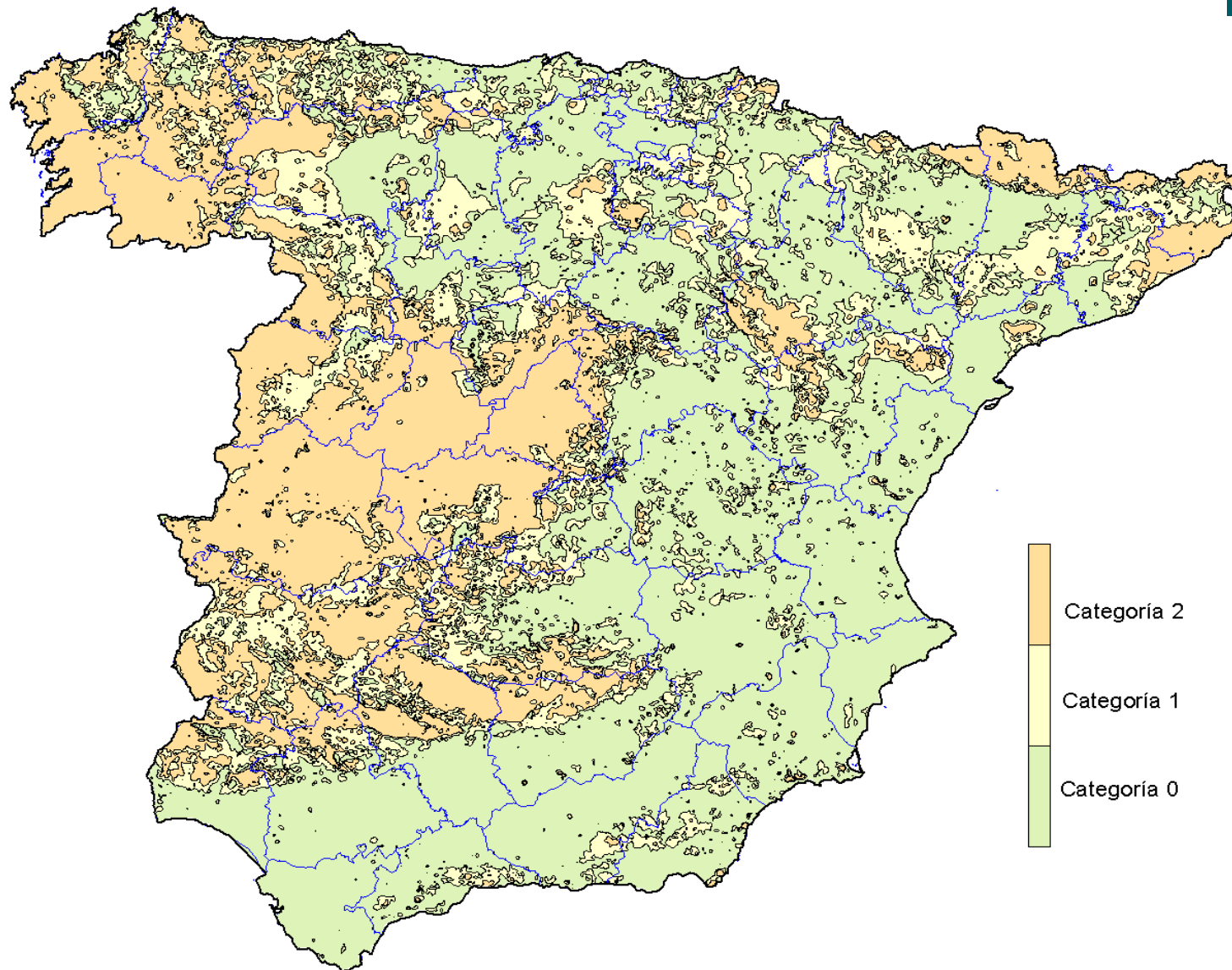
Monitoring of exposures from natural sources:

*Royal Decree 178 , 26 of JULY, 2001*  
*Royal Decree 279, 18 of NOVEMBER, 2010*  
*Royal Decree 22, 26 of JANUARY, 2012*



## Radon Potential Exposure

Categorías de exposición potencial al radón



Data Source: CSN



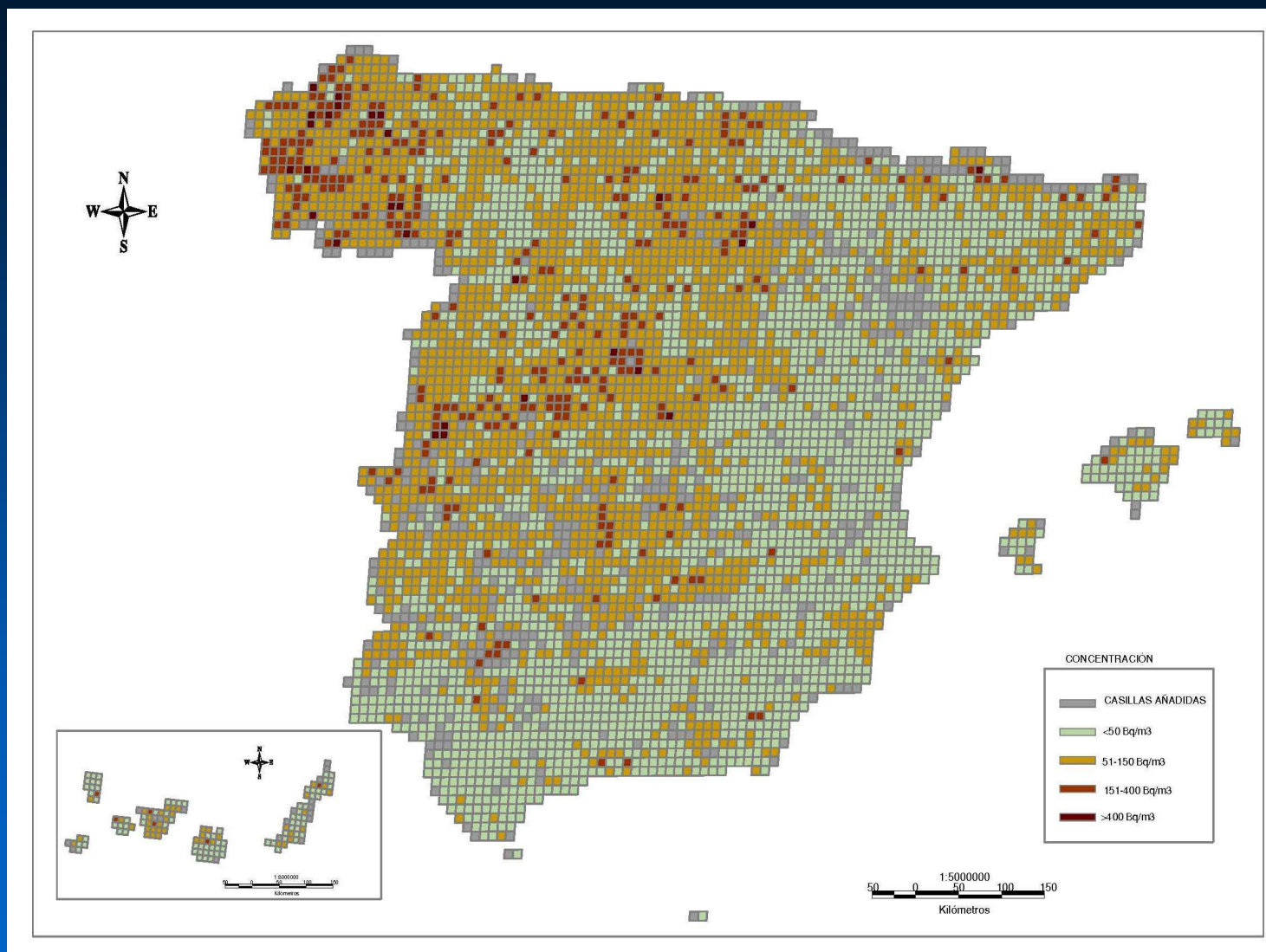
## RADON 10X10



**University Autonom  
of Barcelona**

**University of Santiag  
de Compostela**

**University of Cantabria**

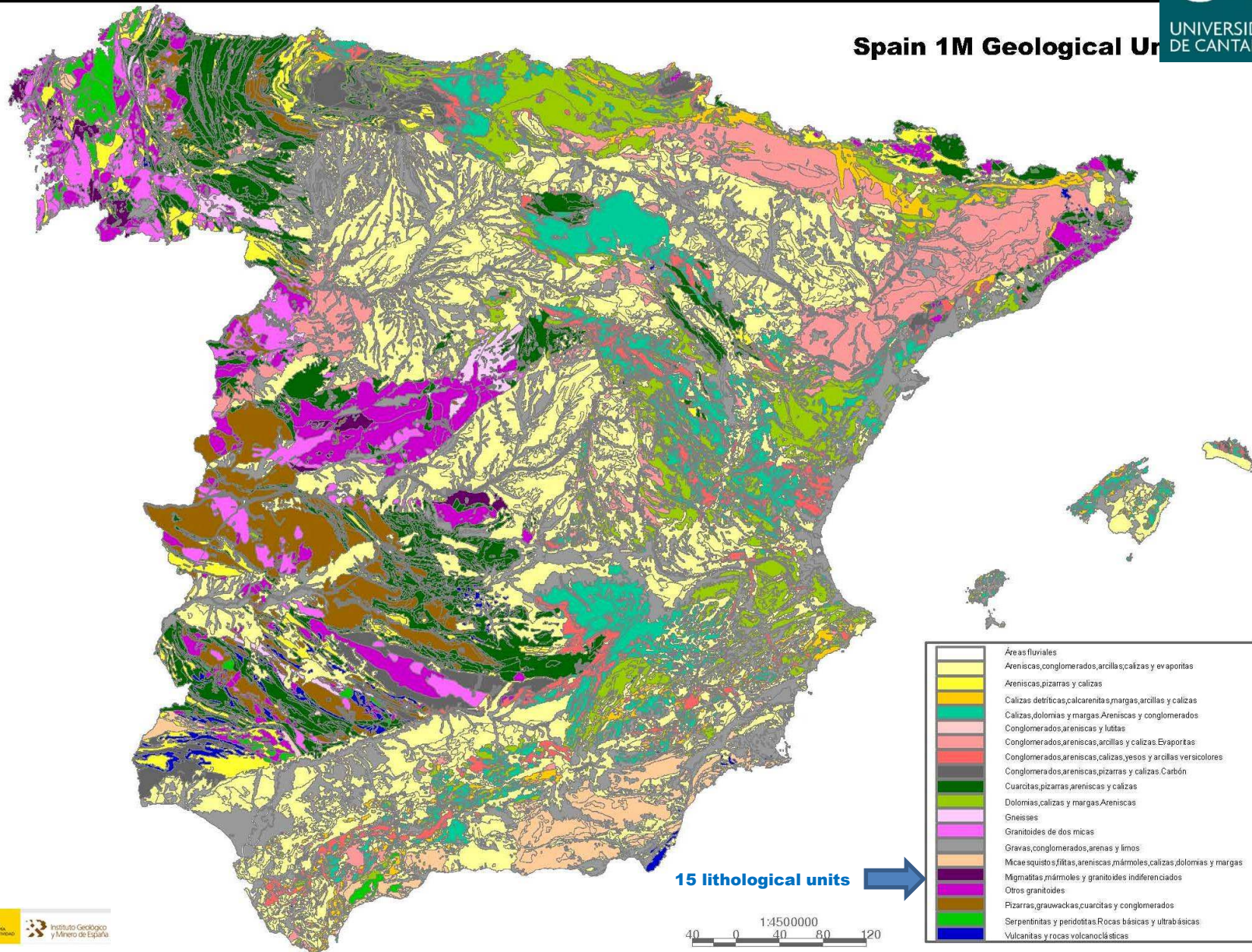


**15.000 indoor radon data**



# Spain 1M Geological Units

Spain 1M Geological Units



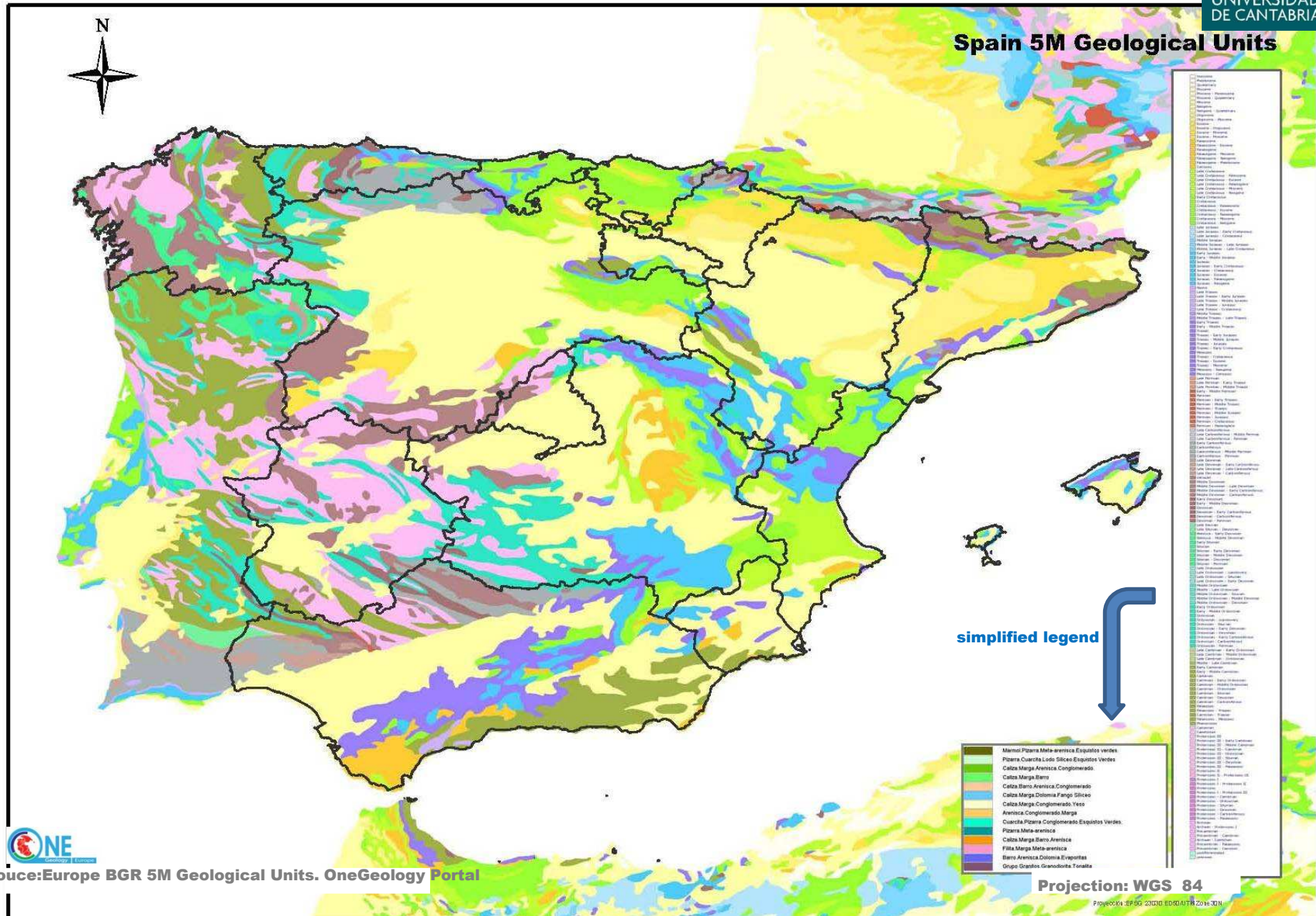
15 lithological units

1:4500000  
0 40 80 120  
Kilómetros

Projection: ED50/UTM 30N



# Spain 5M Geological Units

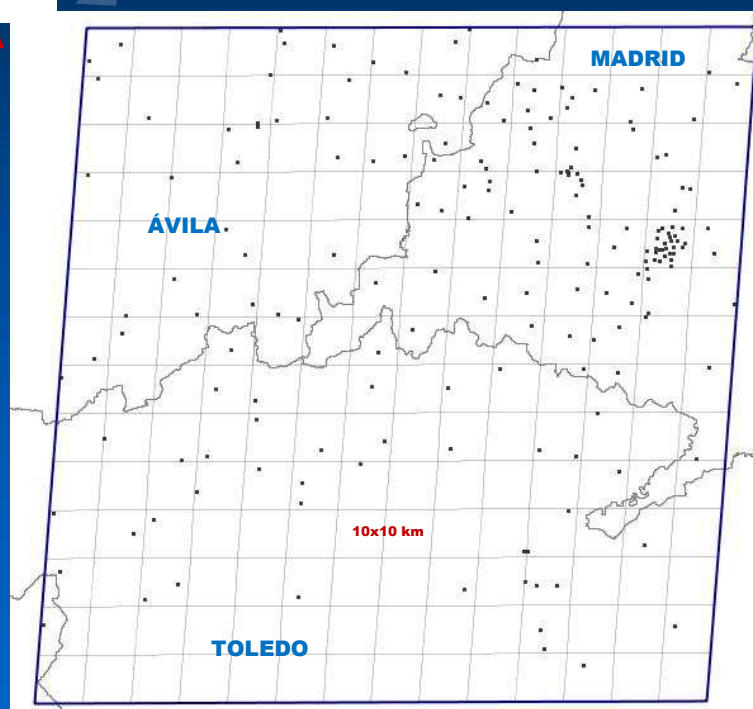


study area 140x140 km.2

Database

CASILLA	ID	LOCALIDAD	X	Y	COD	MedidaCOD
AV13	72.0	Herreros de Suso	327987.99396	4518874.99...	T99112	128.0
AV13	74.0	S.García de Angelmos	321482.99275	4515268.99...	T65290	19.0
AV16	101.0	Mingorria	359324.9978	4512526.99...	T65410	68.0
AV17	102.0	Vega de SMM	361491.99795	4521849.99...	W32016	83.0
AV17	105.0	SºDomingo de las Pos	362108.998	4519153.99...	W32448	182.0
AV18	110.0	Maello	372661.99866	4518655.99...	P79114	75.0
AV18	110.0	Maello	372661.99866	4518655.99...	W32327	171.0
AV21	119.0	Mirueña Infanzones	323400.99316	4511654.99...	T65562	312.0
AV22	137.0	Narillos del Rebol	333876.995	4503384.99...	T65426	81.0
AV24	149.0	Avila(n)	356787.99762	4502502.99...	T75957	124.0
AV24	149.0	Avila(n)	356787.99762	4502502.99...	T99087	26.0
AV25	468.0	Avila(e)	360543.41125	4502893.91...	P79376	318.0
AV26	160.0	SMMdel Cubillo	375811.99882	4511312.99...	T64886	14.0
AV26	162.0	Liraca Miguel	371277.9986	4503536.99...	T21577	181.0
AV32	193.0	La Colla	350679.99708	4501072.99...	P68506	200.0
AV32	196.0	Avila(s)	356680.99762	4501580.99...	T21669	199.0
AV32	200.0	Aldea Rey Niño	352321.99725	4494271.99...	T65266	73.0
AV32	196.0	Avila(s)	356680.99762	4501580.99...	T21721	156.0
AV32	196.0	Avila(s)	356680.99762	4501580.99...	T21454	434.0
AV32	196.0	Avila(s)	356680.99762	4501580.99...	W83650	48.0
AV34	203.0	La Cañada	373348.99872	4495304.99...	T20343	920.0
AV35	204.0	Navalperal de Pinare	380652.99905	4494499.99...	T99134	24.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99048	123.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99055	108.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99220	230.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T98980	362.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99126	91.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99120	45.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99143	74.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	P79362	198.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99072	276.0
AV35	206.0	Navas del Marques	387269.99929	4495542.99...	T99241	24.0

140 KM

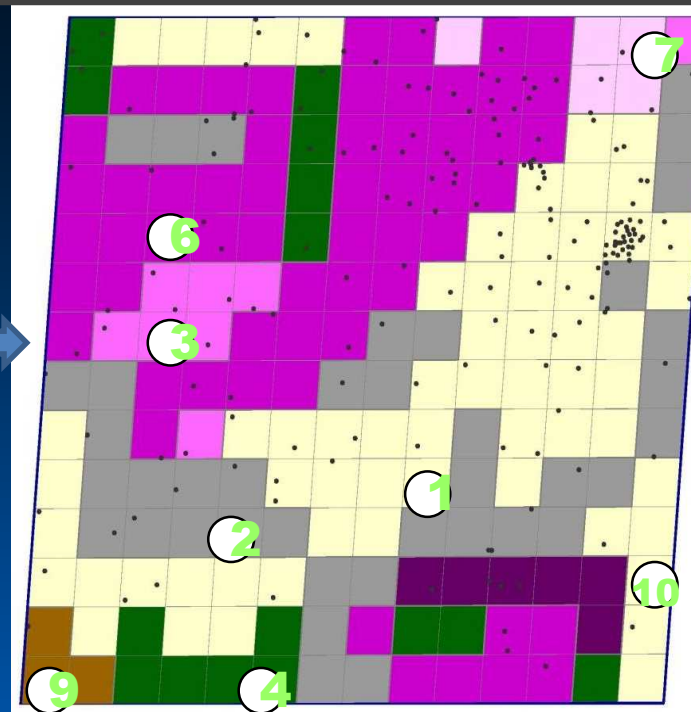
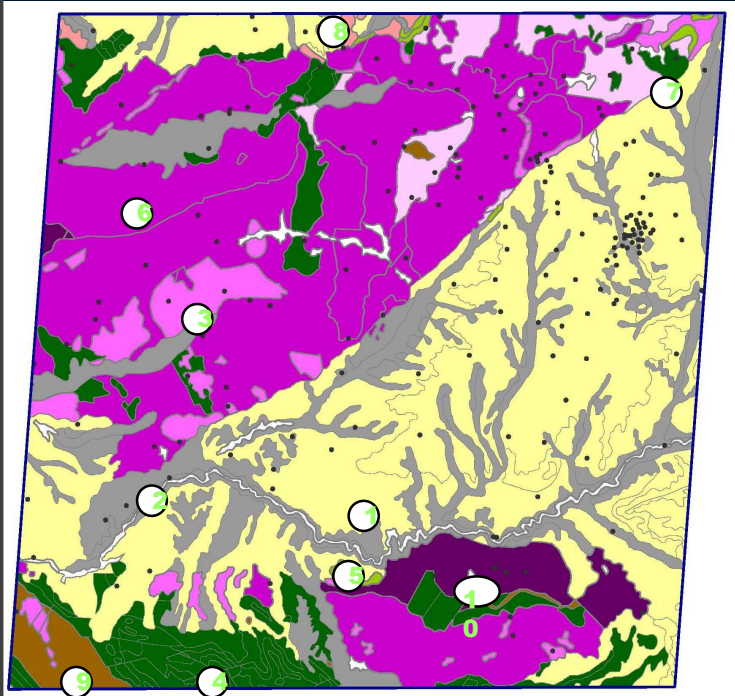


140 KM

**Study area:**  
- 224 grids 10x10 km2  
- 485 data



## Spain 1M Geological Units. Study Area.

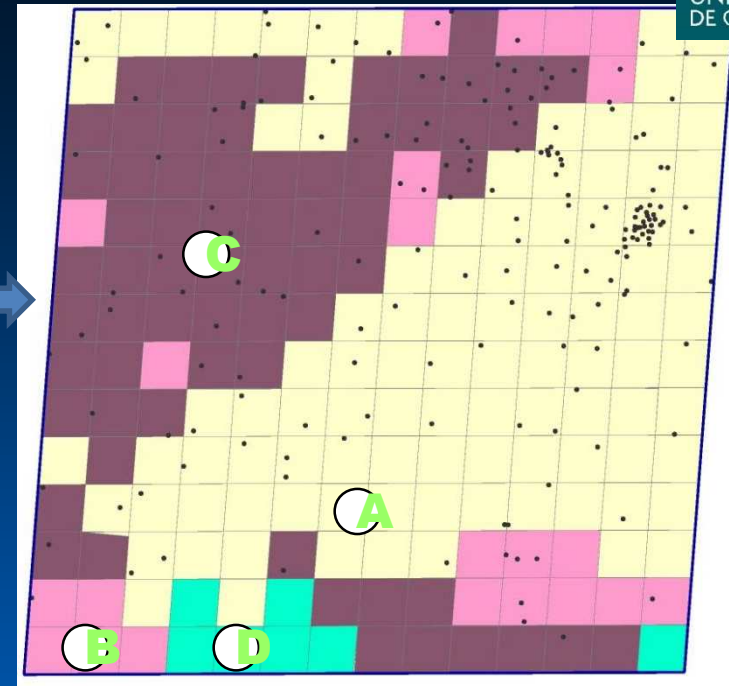
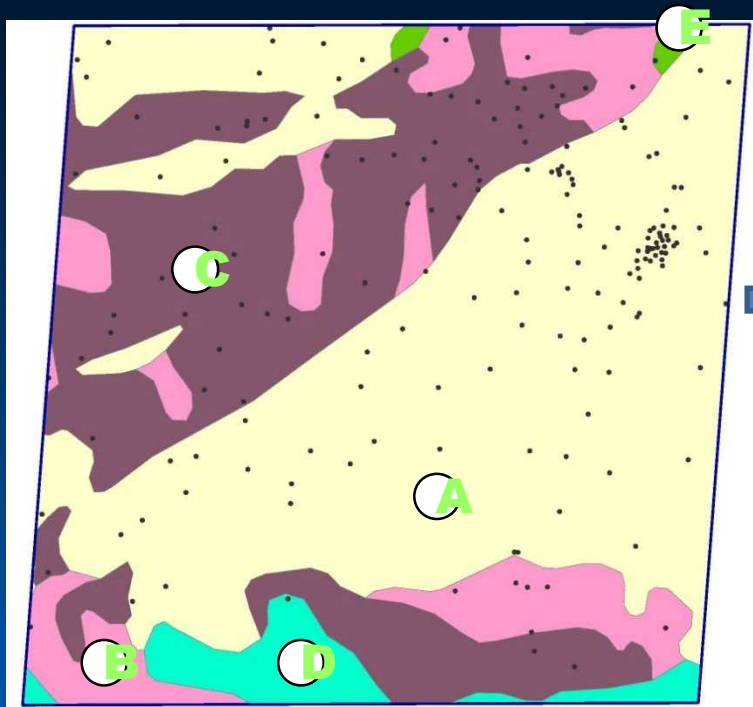


### Geological Units:

- 1. Sandstones, conglomerates, clays, limestones and evaporites**
- 2. Gravels, conglomerates, sands and silts**
- 3. Two-mica granites**
- 4. Quartzites, slates, sandstones and limestones**
- 5. Dolomite, limestone and marl. Sandstones**
- 6. Other granitoids**
- 7. Gneisses**
- 8. Conglomerates, sandstones, clays and limestones. evaporites**
- 9. Slates, grauwackas, quartzites and conglomerates**
- 10. Migmatites, marbles and undifferentiated granitoids**

	1 M GEOLOGICAL UNITS	Median	A.M	s.d	G.M	s.d	Max.	Min.	Nº Samples
	Sandstones, conglomerates, clays, limestones and evaporites	76,00	82,46	37,89	72,61	1,8	170	5	217
	Sandstones, shales and limestones								
	Limestones, dolomites and marls. Sandstones and conglomerates								
	Conglomerates, sandstones, clays and limestones. evaporites								
	Conglomerates, sandstone, limestone, gypsum and clay versicolor.								
	Conglomerates, sandstones, shales and limestones. Coal.								
	Quartzites, slates, sandstones and limestones	74,00	135,60	141,19	98,01	2,1	472	57	10
	Dolomites, limestones and marls. sandstones								
	Gneisses.	367,50	357,50	317,32	207,65	3,5	647	58	6
	Two-mica granites	194,00	165,00	58,15	153,44	1,5	274	45	21
	Gravels, conglomerates, sands and silts	61,00	77,52	46,09	67,36	1,7	185	14	50
	Migmatites, marbles and undifferentiated granitoids	44,00	43,00	2,24	42,95	1,1	44	39	5
	Other granitoids	138,00	148,29	85,42	125,52	1,8	475	5	175
	Slates, grauwackas, quartzites and conglomerates	12,00	12,00	-	12,00	-	12	12	1
	Serpentinities and peridotites. Basic and ultrabasic rocks.								
	Volcanics and volcaniclastic rocks								

## Spain 5M Geological Units. Study Area.



### Geological Units:

**A. Marl, conglomerate, limestone, gypsum**

**B. Gneiss, mylonite**

**C. granite group, granodiorite, tonalite**

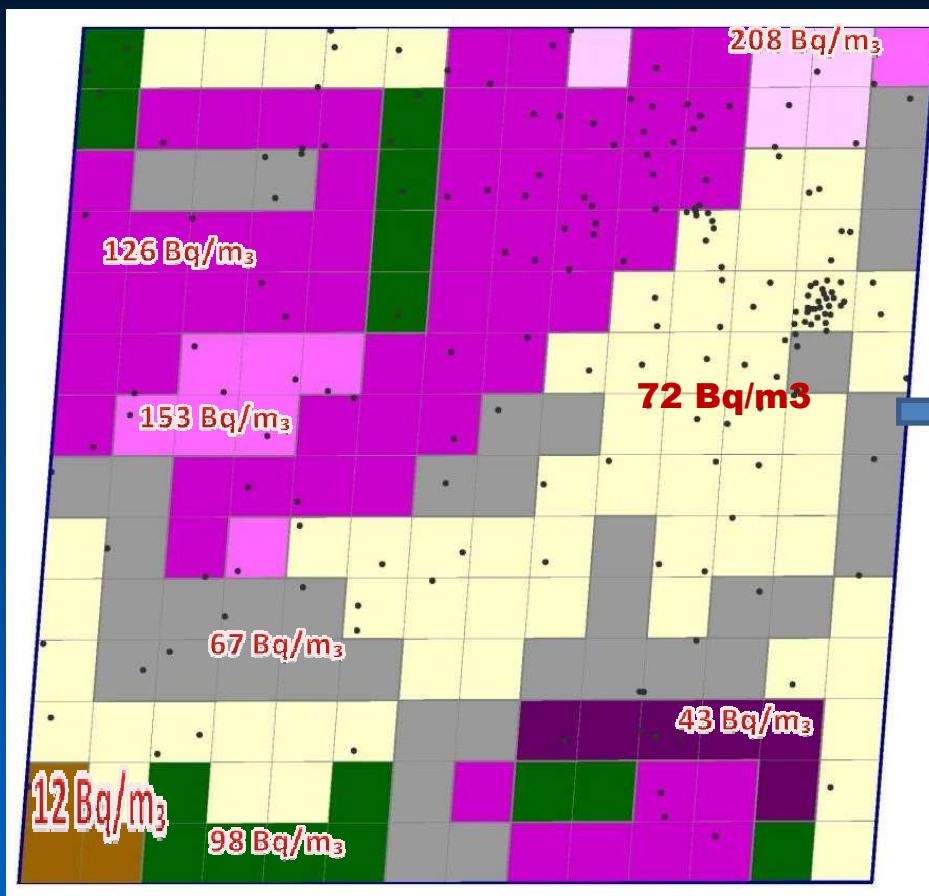
**D. Quartzite, shale/slate, greenschist, conglomerate**

**E. Limestone, sandstone, marl, mud**

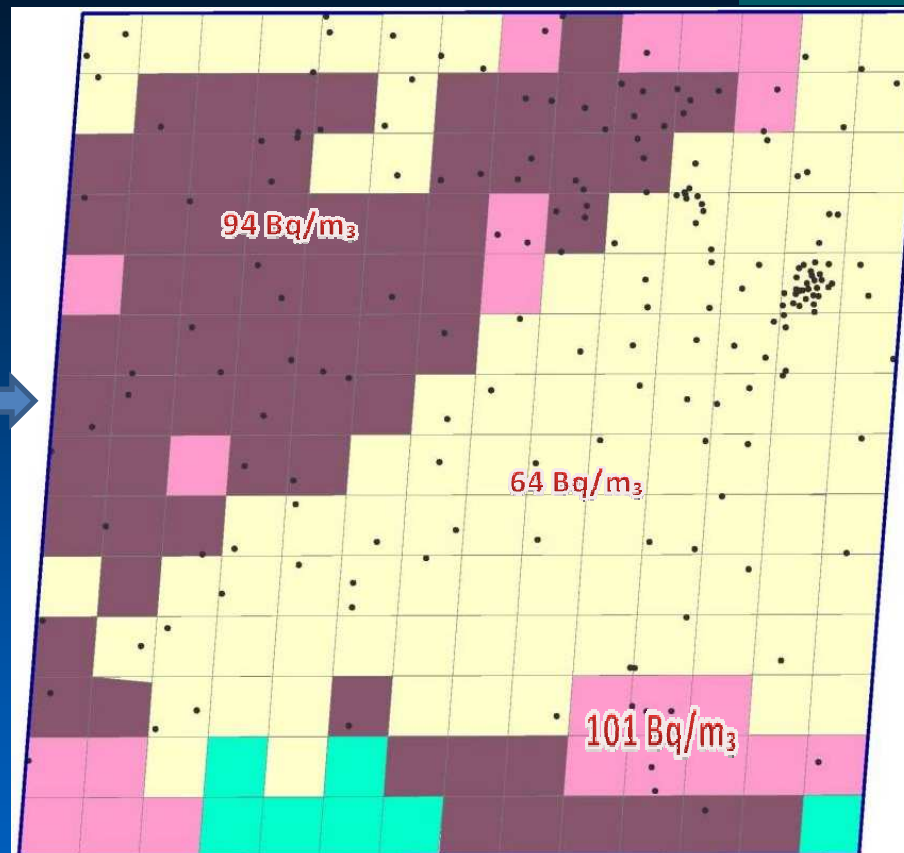
5 M GEOLOGICAL UNITS	Median	A.M	s.d	G.M	s.d	Max.	Min.	Nº Samples
Meta-sandstone, Marble, Slate, greenschist								
Sandstone, Marl, Limestone, conglomerates								
Limestone, Marl mud								
Sandstone, Mud, Limestone, conglomerates								
Limestone, Dolomite, Marble, Silicon Fango								
Marga, Conglomerate, Limestone, Gypsum	64,00	87,01	89,39	64,03	2,2	920	4	275
Sandstone, Conglomerate, Marl								
Quartzite, Slate, Greenschist, conglomerates								
Slate, Meta-sandstone								
Sandstone, Mud, Marl, limestone								
Phyllite, Meta-sandstone, Marl	83,00	185,63	227,38	100,90	3,1	939	12	32
Mud, Sandstone, Dolomite, evaporites								
Granites Group, Granodiorite, tonalite	104,50	140,28	129,85	94,42	2,5	737	5	178

# Comparison data. Study Area.

1M Geological Units. Study Area.



5M Geological Units. Study Area.



1 M GEOLOGICAL UNITS		id	G.M
	Sandstones, conglomerates, clays, limestones and evaporites	1	72,61
	Quartzites, slates, sandstones and limestones	4	98,01
	Gneisses.	7	207,65
	Two-mica granites	3	153,44
	Gravels, conglomerates, sands and silts	2	67,36
	Migmatites, marbles and undifferentiated granitoids	10	42,95
	Other granitoids	6	125,52
	Slates, grauwackas, quartzites and conglomerates	9	12,00

5 M GEOLOGICAL UNITS		id	G.M
	Marga. Conglomerate. Limestone. Gypsum	A	64,03
	Phyllite. Meta-sandstone. Marl	B	100,90
	Granites Group. Granodiorita. tonalite	D	94,42



**LOCAL GOAL**

**ROUND TABLE  
EUROPEAN GEOGENIC MAP  
Thursday 9:00-14:00**

## FUTURE GOALS

COMPLETE THE NATIONAL INDOOR RADON MAPPING IN  
DWELLINGS

PARTICIPATE IN THE EUROPEAN GEOGENIC RADON MAP WITH  
THE ANALYSIS OF THE SPANISH DATA AVAILABLE

ENSURANCE THE QUALITY OF MEASUREMENTS BY  
PARTICIPATION/ORGANIZATION OF INTERCOMPARISON  
EXERCISES UNDER FIELD CONDITIONS AND CALIBRATION  
CHAMBERS

MEASURING OCCUPATIONAL RADON EXPOSURE AT A  
NATIONWIDE SCALE ACCORDING TO THE SPANISH LAW  
*Titulo VII BOE 178 DE 26 DE JULIO DE 2001-2012*

SPANISH SOIL RADON GAS MAPPING WILL BE START IN 2013

# **LABORATORY OF NATURAL RADIOACTIVITY (LRN)**

# LRRN Main building



**... one step further about quality**



**International Intercomparison exercise  
under field conditions**

**42 LABORATORIES**

**17 COUNTRIES**



# LABORATORIO DE RADIOACTIVIDAD NATURAL (LRN)



Uranium mine  
Saelices el Chico  
Salamanca, Spain





**Rn  
in soil**



**External gamma  
exposure**



**Rn in air (indoors, outdoors)**



**Rn in water**



**Radon exhalation  
(soil, building materials)**

## some remarks

THE LRN PROVIDE US A BETTER KNOWLEDGE OF THE RESPONSE OF DETECTOR UNDER FIELD CONDITIONS, WHERE MORE VARIABLES AFFECT THE MEASUREMENT OF NATURAL RADIATION

THE LRN LET US COMPLEMENTARY TEST OF DEVICES AND SYSTEMS

NEW COMPARISONS (DOSIMETERS, ETC...) ARE PLANNED FOR THE FUTURE

IMPROVEMENTS ARE NOW ONGOING TO DEVELOP MORE EXPERIMENTS IN RADON ACTIVITIES

THE LRN WANTS TO BE A MEETING PLACE FOR RESEARCHERS IN NATURAL RADIATION

# SCHEDULE FOR 2013

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE

EXT.  $\gamma$

EXT.  $\gamma$

TLD's

TLD's

Rn soil

Rn general

JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER

EXT.  $\gamma$

EXT.  $\gamma$

FREE

Rn soil

Rn indoor

Rn indoor

# **EUROPEAN ASSOCIATION OF RADON SCIENTISTS AND TECHNOLOGISTS (EARST)**



# EARST

## European Association of Radon Scientists and Technologists

This site is aim for informing all members of  
EARST and interchanging opinions and debate.

[Enter](#)

### Forum

Access to the Forum of EARST where you  
will be able to discuss and give new ideas  
on everything related to radon.

[EARST Forum](#)

### We welcome you

We have set a forum in order to discuss  
and talk all matters about Radon. Please  
contact us if you have any comments on the  
web or any ideas for improving it.

### Partners

Universidad de Cantabria cooperates with  
Earst



**[www.earst.eu](http://www.earst.eu)**

## **some goals...**

**To promote public awareness of radon measurement, radon mitigation and new construction radon reduction techniques.**

- **To ensure quality standards are developed and adopted in radon measurement, radon mitigation and in construction of new radon reduction techniques.**
- **To provide a community for education, sharing of ideas, resources and research.**
  - **To provide an effective partnership between radon professionals in the field and other interested public and private organizations.**
  - **To organize the annual Radon conference combining scientific presentations and technical exhibitions from companies working on radon gas.**

**+ YOUR PROPOSALS HERE!!**



- Portada
- ¿Qué es el Radón?
- Normativa
- Biblioteca
- Enlaces
- Contacto

**Categorías**

Noticias elradon.com

Otras Noticias

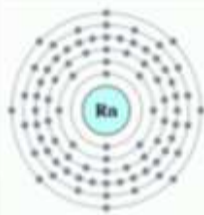
Proyectos de Investigación

Artículos elradon.com

**elradon.com**

Cátedra de Física Médica.  
Departamento de Ciencias Médicas y Quirúrgicas.  
Universidad de Cantabria.

**Noticias de elradon.com**



**El Grupo Radon de la Cátedra de Física Médica de la Universidad de Cantabria impartirá el curso: "Prevención y detección de material radiactivo en aceras"**



**First East European Radon Symposium (FERAS 2012) September 2th - 5th, 2012 Cluj-Napoca, Romania**

VII Jornadas sobre calidad en el control de la

Third International Geo-Hazards Research

[www.elradon.com](http://www.elradon.com)



**Děkuji za vaši pozornost**