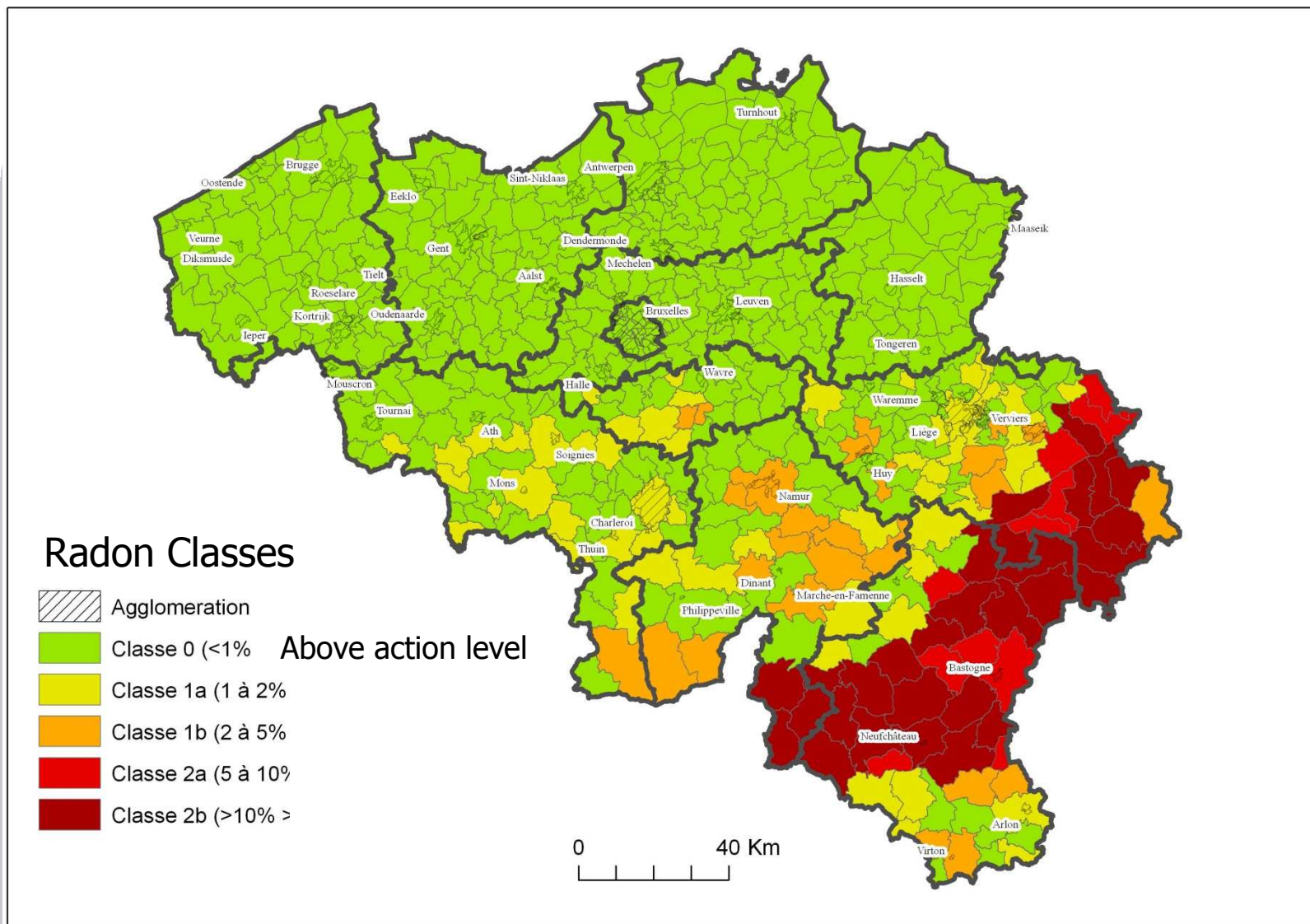




RADON RISK MAPPING BASED ON ONEGEOLOGY-EUROPE GEOLOGICAL UNITS

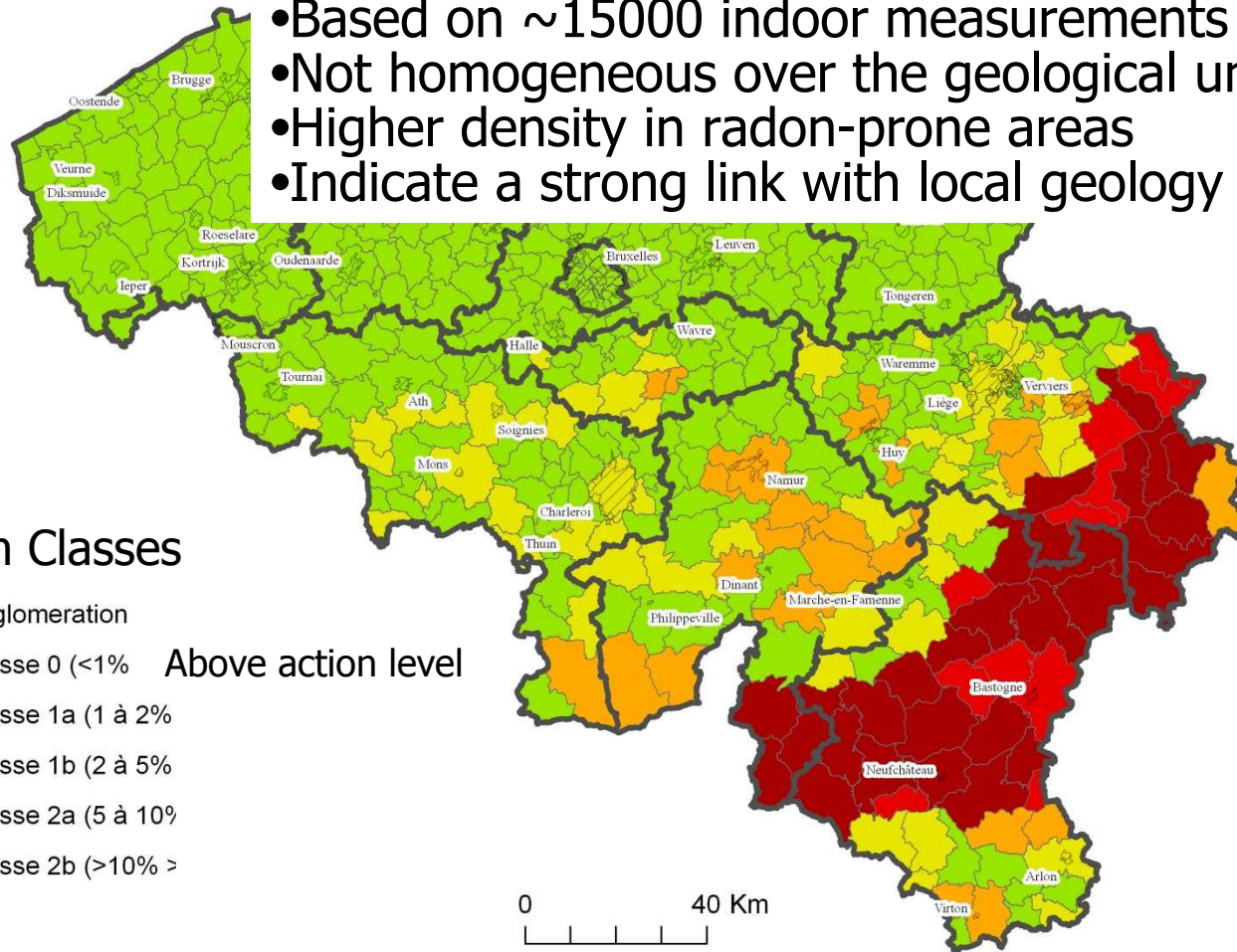
Boris Dehandschutter

Federal Agency for Nuclear Control, Department Health &
Environment, Brussels, Belgium









Radon risk map

- Based on ~15000 indoor measurements
- Not homogeneous over the geological units
- Higher density in radon-prone areas
- Indicate a strong link with local geology



Radon Classes

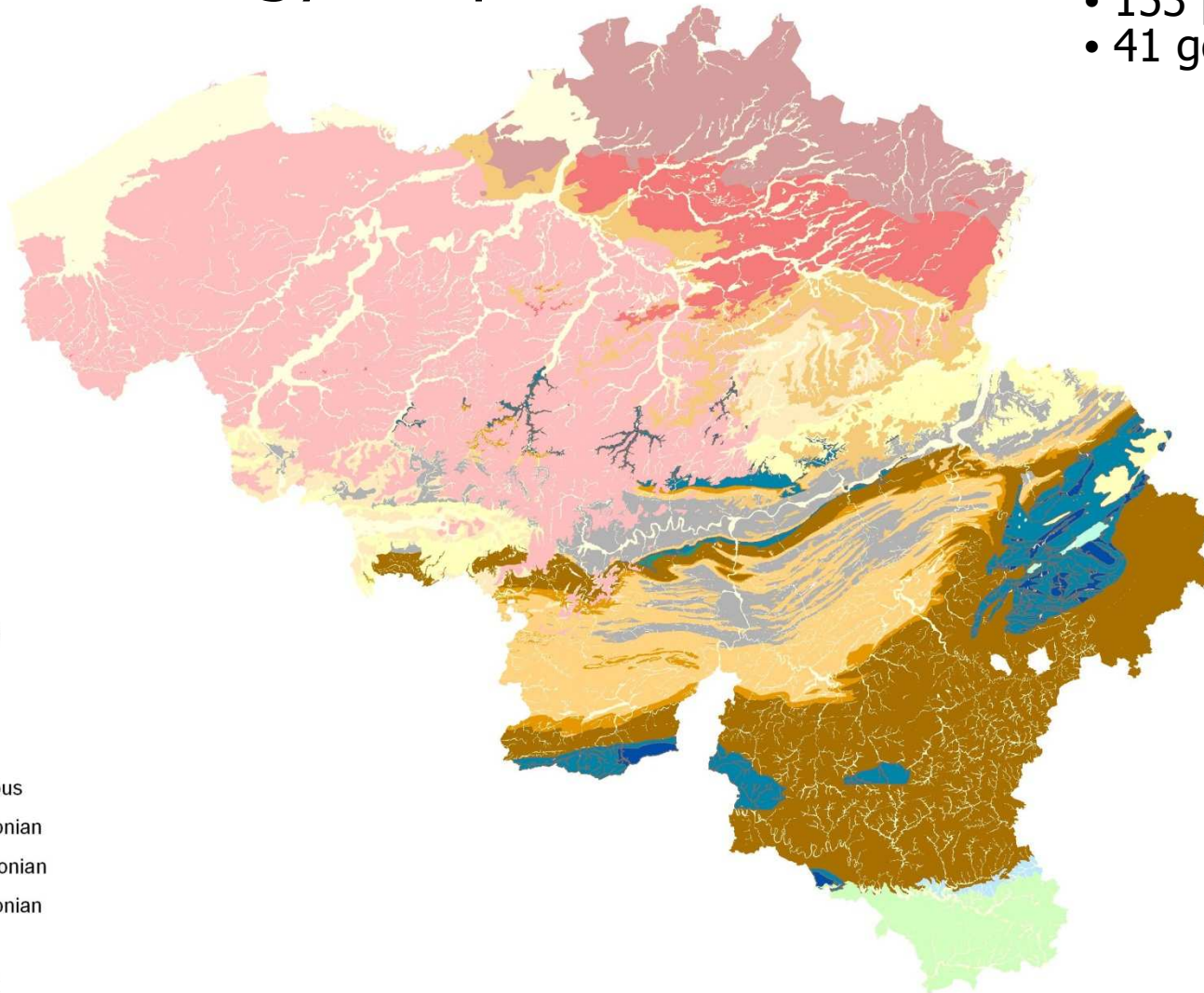
	Agglomeration
	Classe 0 (<1% Above action level)
	Classe 1a (1 à 2%)
	Classe 1b (2 à 5%)
	Classe 2a (5 à 10%)
	Classe 2b (>10% >

OneGeologyEurope

- 153 polygons
- 41 geological ages

be_surface

lowerAge



OneGeologyEurope

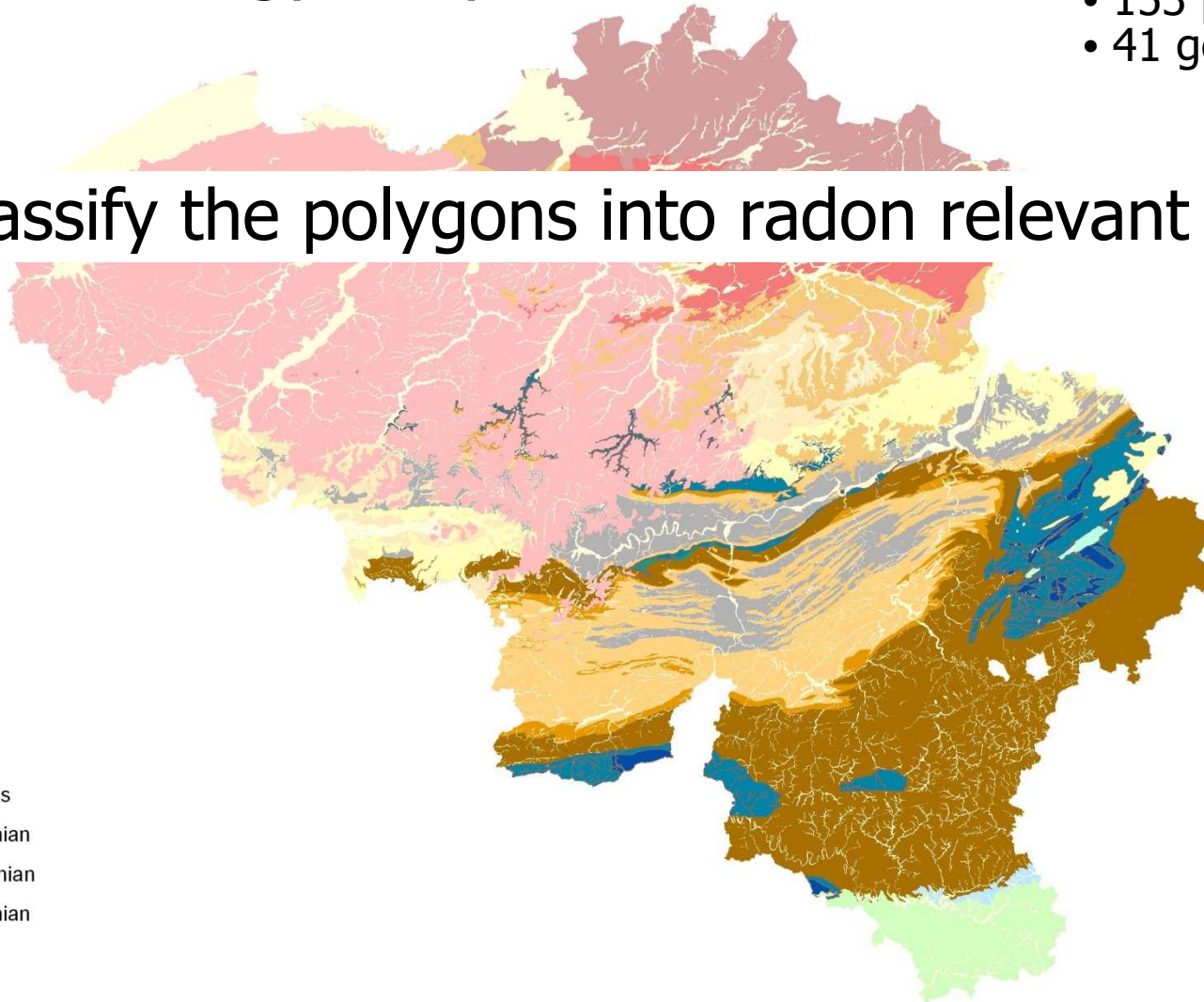
- 153 polygons
- 41 geological ages

→ Classify the polygons into radon relevant units

be_surface

lowerAge

- Holocene
- Pliocene
- Miocene
- Oligocene
- Eocene
- Paleocene
- Cretaceous
- Jurassic
- Triassic
- Permian
- Carboniferous
- Upper Devonian
- Middel Devonian
- Lower Devonian
- Silurian
- Ordovician
- Cambrian



OneGeologyEurope

- 153 polygons
- 41 geological ages

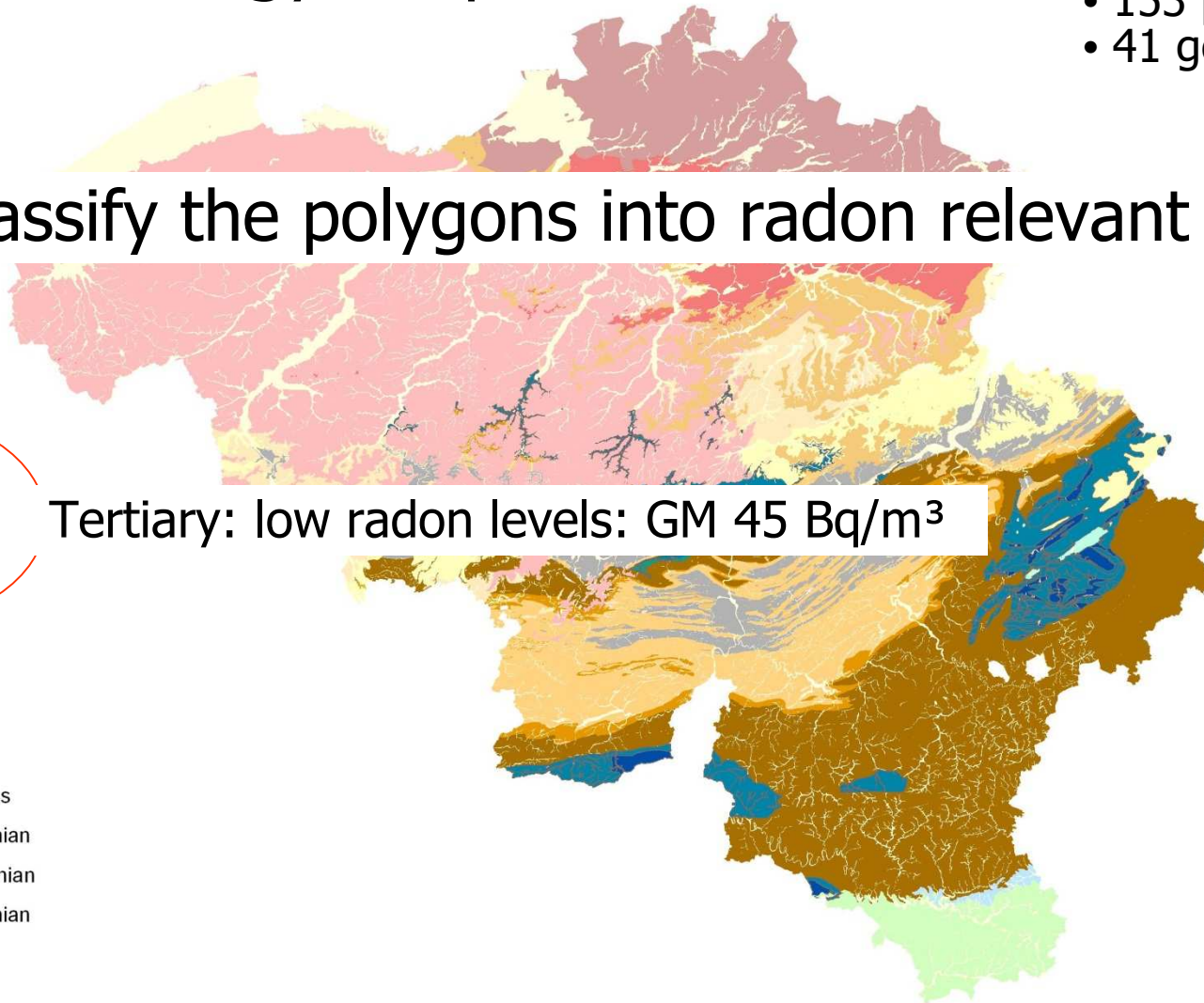
→ Classify the polygons into radon relevant units

be_surface

lowerAge

- Holocene
- Pliocene
- Miocene
- Oligocene
- Eocene
- Paleocene
- Cretaceous
- Jurassic
- Triassic
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- Upper Devonian
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- Lower Devonian
- Silurian
- Ordovician
- Cambrian

Tertiary: low radon levels: GM 45 Bq/m³



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→ Classify the polygons into radon relevant units

be_surface

lowerAge

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- Pliocene
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- Cretaceous
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- Carboniferous
- Upper Devonian
- Middel Devonian
- Lower Devonian
- Silurian
- Ordovician
- Cambrian

Tertiary: low radon levels: GM 45 Bq/m³

Mesozoic: medium radon levels: 58 Bq/m³

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- 41 geological ages

→ Classify the polygons into radon relevant units

be_surface

lowerAge

- Holocene
- Pliocene
- Miocene
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- Eocene
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- Cretaceous
- Jurassic
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- Permian
- Carboniferous
- Upper Devonian
- Middel Devonian
- Lower Devonian
- Silurian
- Ordovician
- Cambrian

Tertiary: low radon levels: GM 45 Bq/m³

Mesozoic: medium radon levels: 58 Bq/m³

Upper Paleozoic: medium radon levels: 63 Bq/m³

OneGeologyEurope

- 153 polygons
- 41 geological ages

→ Classify the polygons into radon relevant units

be_surface

lowerAge

- Holocene
- Pliocene
- Miocene
- Oligocene
- Eocene
- Paleocene
- Cretaceous
- Jurassic
- Triassic
- Permian
- Carboniferous
- Upper Devonian
- Middel Devonian
- Lower Devonian
- Silurian
- Ordovician
- Cambrian

Tertiary: low radon levels: GM 45 Bq/m³

Mesozoic: medium radon levels: 58 Bq/m³

Upper Paleozoic: medium radon levels: 63 Bq/m³

Lower Paleozoic: high radon levels: 124 Bq/m³

OneGeologyEurope

- 153 polygons
- 41 geological ages

→ Classify the polygons into radon relevant units

be_surface

lowerAge

Holocene

Pliocene

Miocene

Oligocene

Eocene

Paleocene

Cretaceous

Jurassic

Triassic

Permian

Carboniferous

Upper Devonian

Middel Devonian

Lower Devonian

Silurian

Ordovician

Cambrian

Quaternary: medium radon levels: 74 Bq/m³

Tertiary: low radon levels: GM 45 Bq/m³

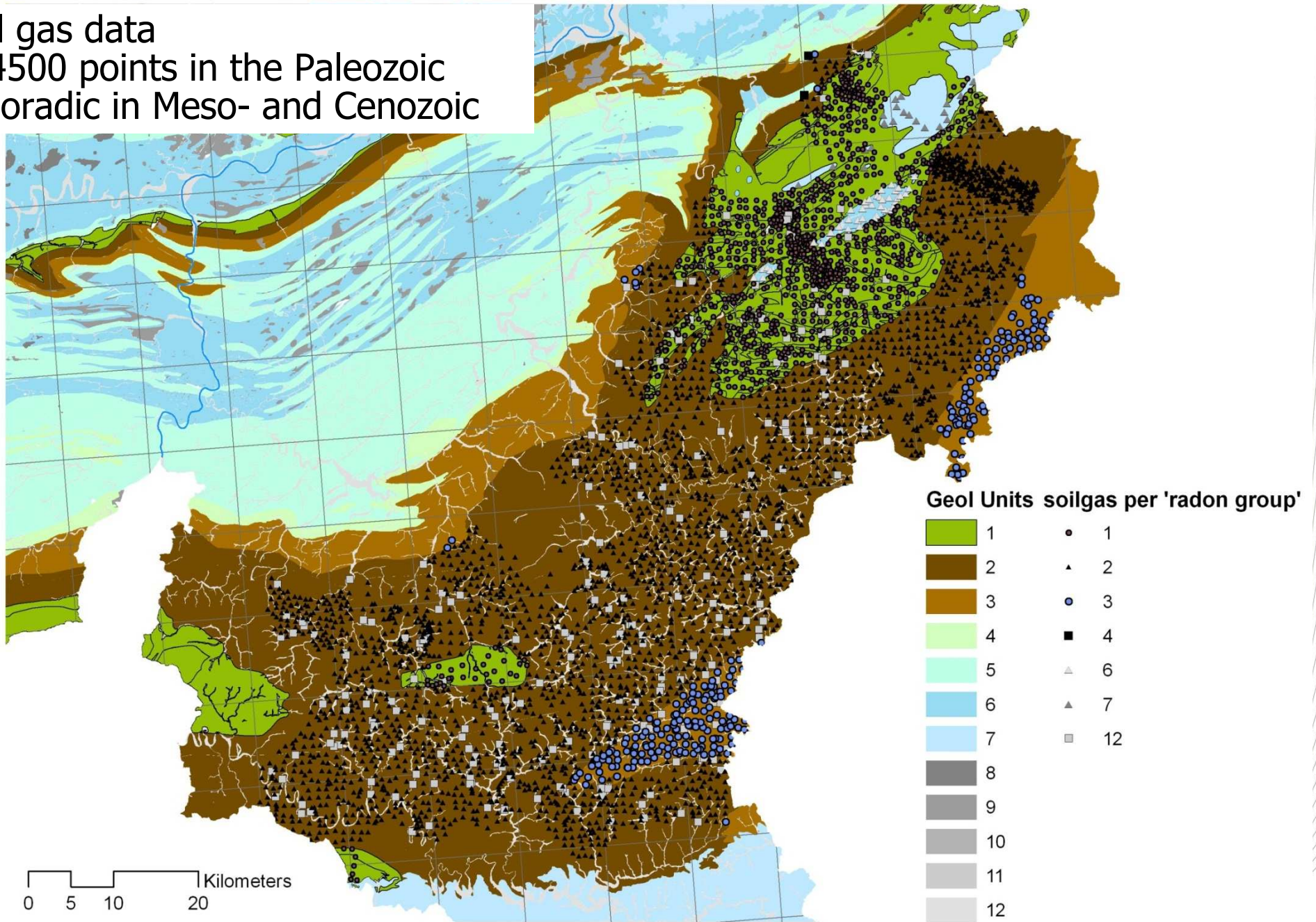
Mesozoic: medium radon levels: 58 Bq/m³

Upper Paleozoic: medium radon levels: 63 Bq/m³

Lower Paleozoic: high radon levels: 124 Bq/m³

Soil gas data

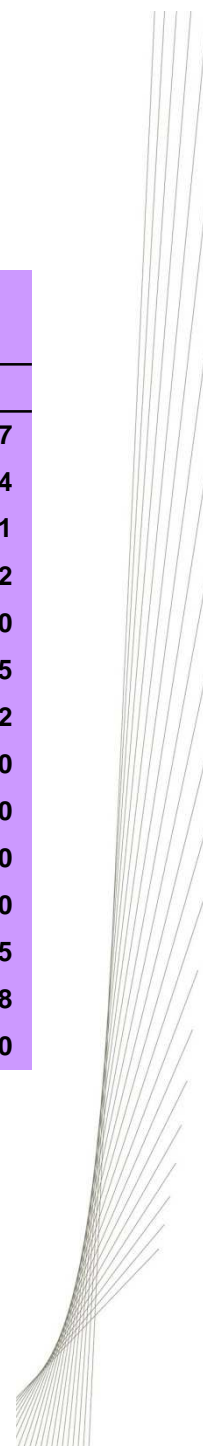
- ~4500 points in the Paleozoic
- Sporadic in Meso- and Cenozoic



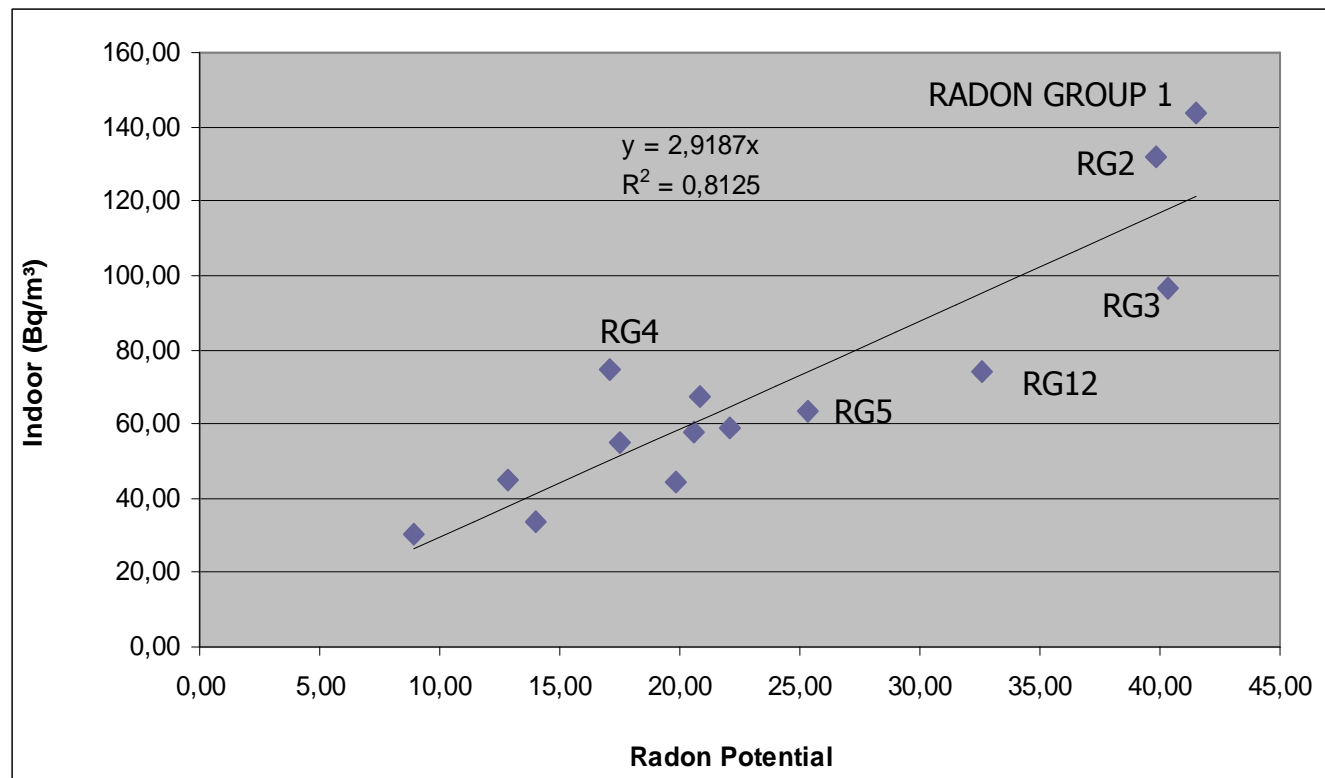
DEVONIAN series	Stage (Etage)	Abbreviation	LM	LITHO
UPPER	Famennian	Fa	4.21	Shale-sandstone-limestone
	Frasnian	Fr	4.13	limestone (some shale-sandstone)
MIDDLE	Givetian	Gv	4.36	almost completely limestone
	Eifelian (Couvinian)	Co	4.43	Shale-sandstone-limestone
LOWER	Emsian	Bt	4.78	Shale-phyllades-sandstone
	Pragian (Siegenian)	Cb	4.93	shale-sandstone-siltstone
	Lochkovien (Gedinnian)	G	4.93	schist-quartzite



	INDOOR			SoilGas		PERM		RP
	GEOL	GM	GSD	GM	GSD	AM	SD	
Cambrian-Silurian	1	144,00	1,05	43,60	0,70	8,89E-12	1,01E-11	41,47
Lower Devonian	2	132,00	0,92	40,70	0,72	9,52E-12	1,16E-11	39,84
Emsian	3	96,50	0,99	36,00	0,72	1,28E-11	1,36E-11	40,31
Middle Devonian	4	74,52	0,87	26,10	1,00	3,18E-12	1,36E-11	17,12
Upper Devonian	5	63,55	0,82	31,56	1,52	9,52E-12	1,16E-11	25,30
M and U Devonian	45	67,10	0,80	31,45	1,55	3,10E-12	1,16E-11	20,85
Carboniferous-Permian	6	58,83	0,95	28,98	1,36	8,20E-12	1,23E-11	22,12
Mesozoic	7	57,59	0,73	26,88	0,73	9,36E-12	9,97E-12	20,60
Paleocene-Eocene	8	44,38	0,88	21,10	2,40	9,36E-12	9,97E-12	19,80
Oligocene	9	55,29	0,73	19,55	1,80	9,36E-12	9,97E-12	17,50
Miocene	10	33,94	0,41	15,21	1,90	9,36E-12	9,97E-12	14,00
Pliocene	11	30,44	0,43	10,02	2,30	9,36E-12	9,97E-12	8,95
Holocen alluvium	12	74,16	1,04	39,98	0,88	1,12E-11	1,26E-11	32,58
Tertiary	812	44,90	0,80	20,12	1,92	2,99E-12	1,39E-11	12,80



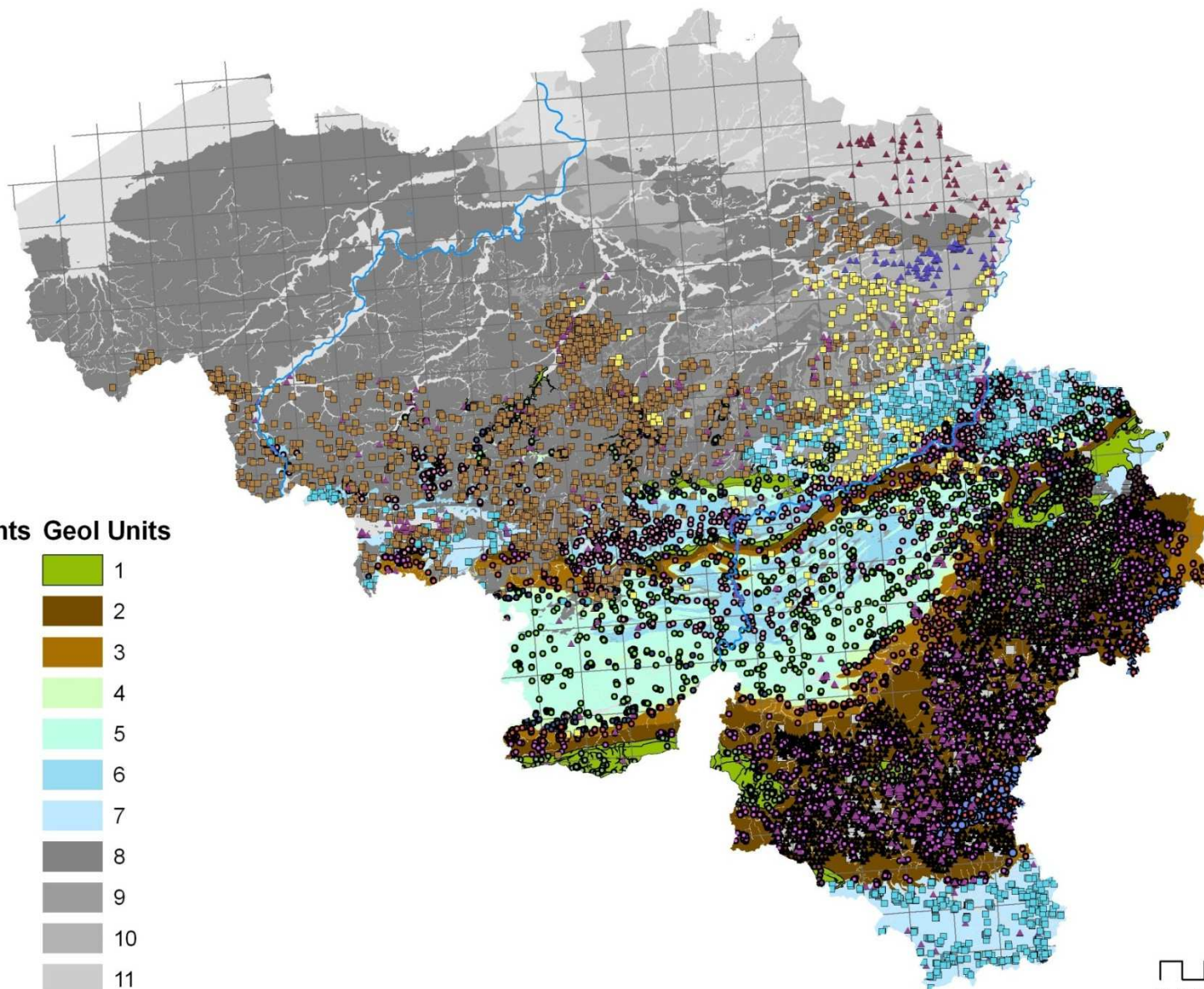
One Geology	CODE
	'RADON GROUP'
Alluvium	12
Pliocene	11
Miocene	10
Oligocene	9
Paleocene	8
Mesozoic	7
Carboniferous-Permian	6
Upper Devonian	5
Middle Devonian	4
Emsian	3
Lower Devonian	2
Cambrian-Silurian	1



Attributes of BE_surfaceGroupRadon

FID	Shape *	ID	name	lowerAge	upperAge	urn litho1	urn litho2	RADON GROUP
4	Polygon	1133	Berchem	Aquitanian	Serravallian	Sand	Clay	10
97	Polygon	9294	Bolderberg	Aquitanian	Burdigalian	Sand	Clay	10
68	Polygon	6044	Weald	Berriasian	Berriasian	Sand	{}	7
37	Polygon	3552	Wanne	Cambrian	Cambrian	Slate	Sandstone	1
58	Polygon	8286	Tubize	Cambrian	Ordovician	Mudstone	Siltstone	1
81	Polygon	5545	La Verne	Cambrian	Cambrian	Slate	Sandstone	1
91	Polygon	546	\$feature.getGmlValueFromGSMLxpath("gsmi:Mapped	Cambrian	Cambrian	Sandstone	Shale	1
112	Polygon	560	Warinsart	Cambrian	Cambrian	Sandstone	Slate	1
151	Polygon	194	F?pin	Cambrian	Lochkovian	Conglomerate	Shale	1
0	Polygon	3743	Trivi?res Chalk Formation	Campanian	Campanian	Chalk	{}	7
21	Polygon	5036	Obourg Chalk	Campanian	Campanian	Chalk	Non-clastic siliceou	7
44	Polygon	7059	Folx-les-Caves	Campanian	Campanian	Chalk	{}	7
119	Polygon	7870	Vaals	Campanian	Campanian	Sand	{}	7
133	Polygon	5198	Spiennes Chalk	Campanian	Campanian	Chalk	Limestone	7
150	Polygon	2836	\$feature.getGmlValueFromGSMLxpath("gsmi:Mapped	Campanian	Campanian	Chalk	{}	7
26	Polygon	6624	Thivencelles	Cenomanian	Cenomanian	Clay	{}	7
140	Polygon	4375	Saint-Vaast Chalk	Coniacian	Coniacian	Chalk	{}	7
77	Polygon	5367	Heers	Danian	Danian	Impure carbonate sedi	Sandstone	8
124	Polygon	9574	Houthem	Danian	Danian	Limestone	{}	8
24	Polygon	27	Arlon	Early/Lower Jurassic	Early/Lower Jurassic	Impure limestone	{}	7
145	Polygon	37	Luxembourg	Early/Lower Jurassic	Early/Lower Jurassic	Limestone	Sand	7
47	Polygon	2171	Ottr?	Early/Lower Ordovician	Middle Ordovician	Slate	Sandstone	1

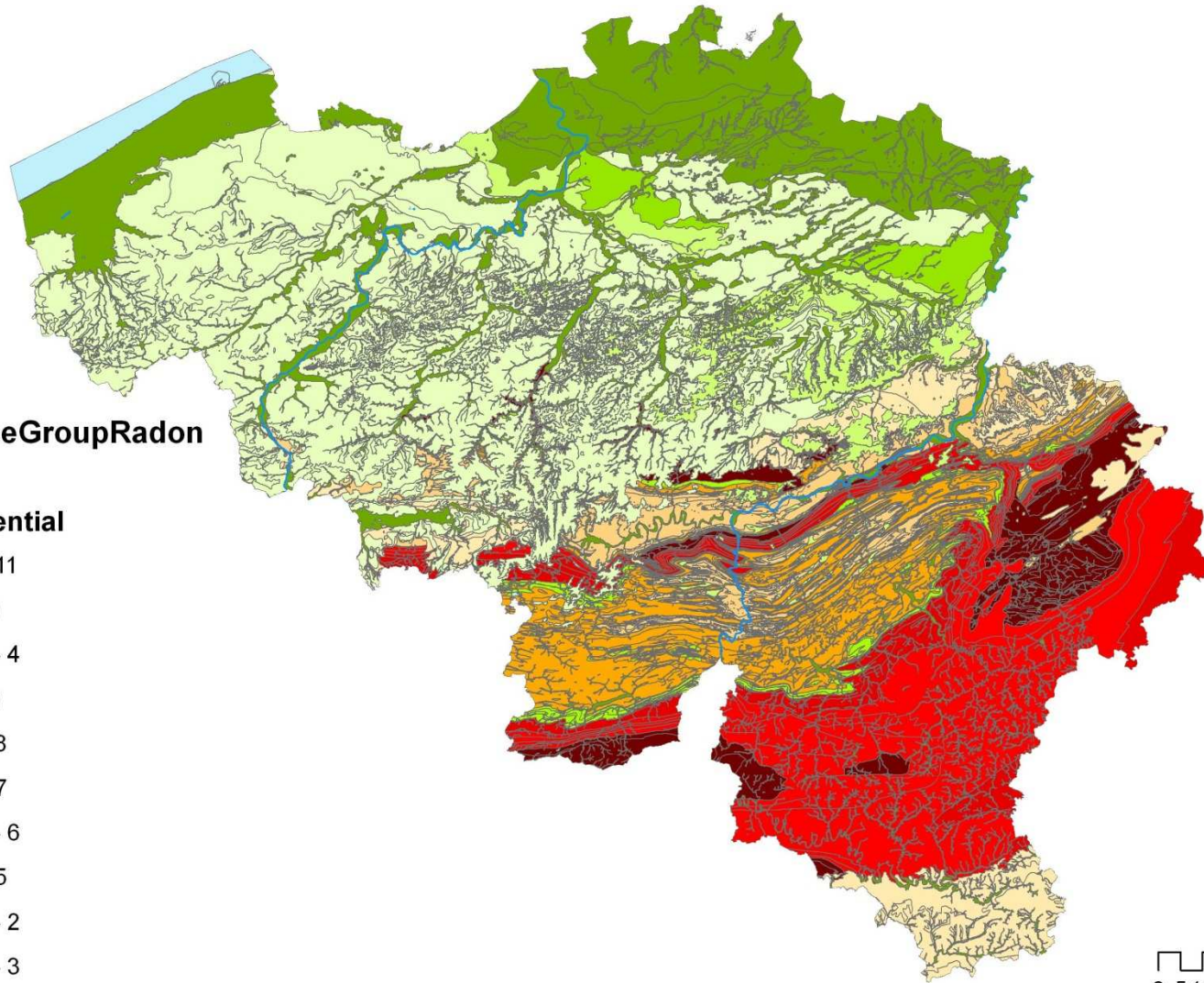
Record: 2 Show: All Selected Records (0 out of 153 Selected) Options



Measurements Geol Units






○	1	■	1
◐	2	■	2
◑	3	■	3
◒	4	■	4
◓	5	■	5
◔	6	■	6
◕	7	■	7
◖	8	■	8
◗	9	■	9
◘	10	■	10
◙	11	■	11
◚	12	■	12

0 5 10 20 Kilometers

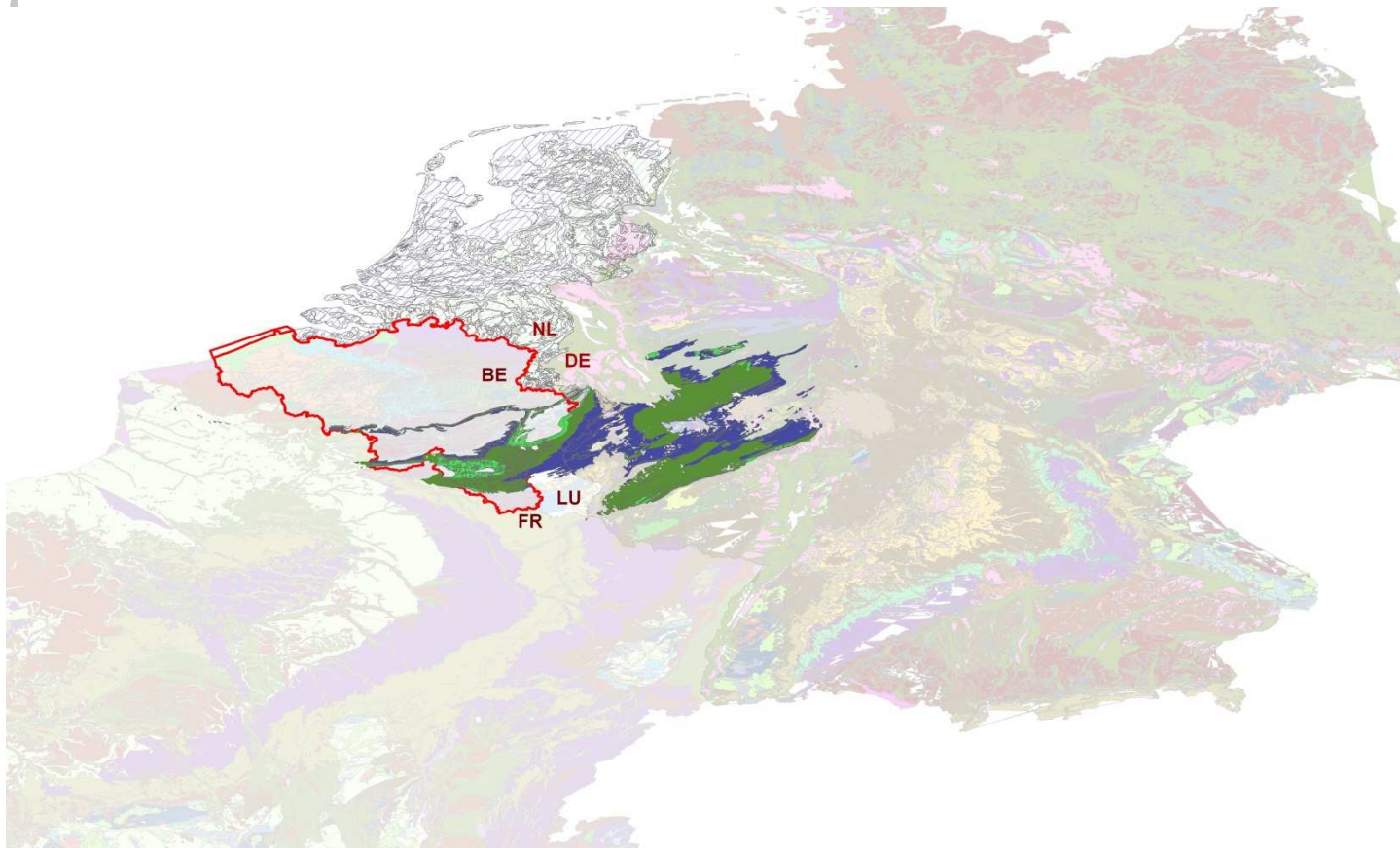


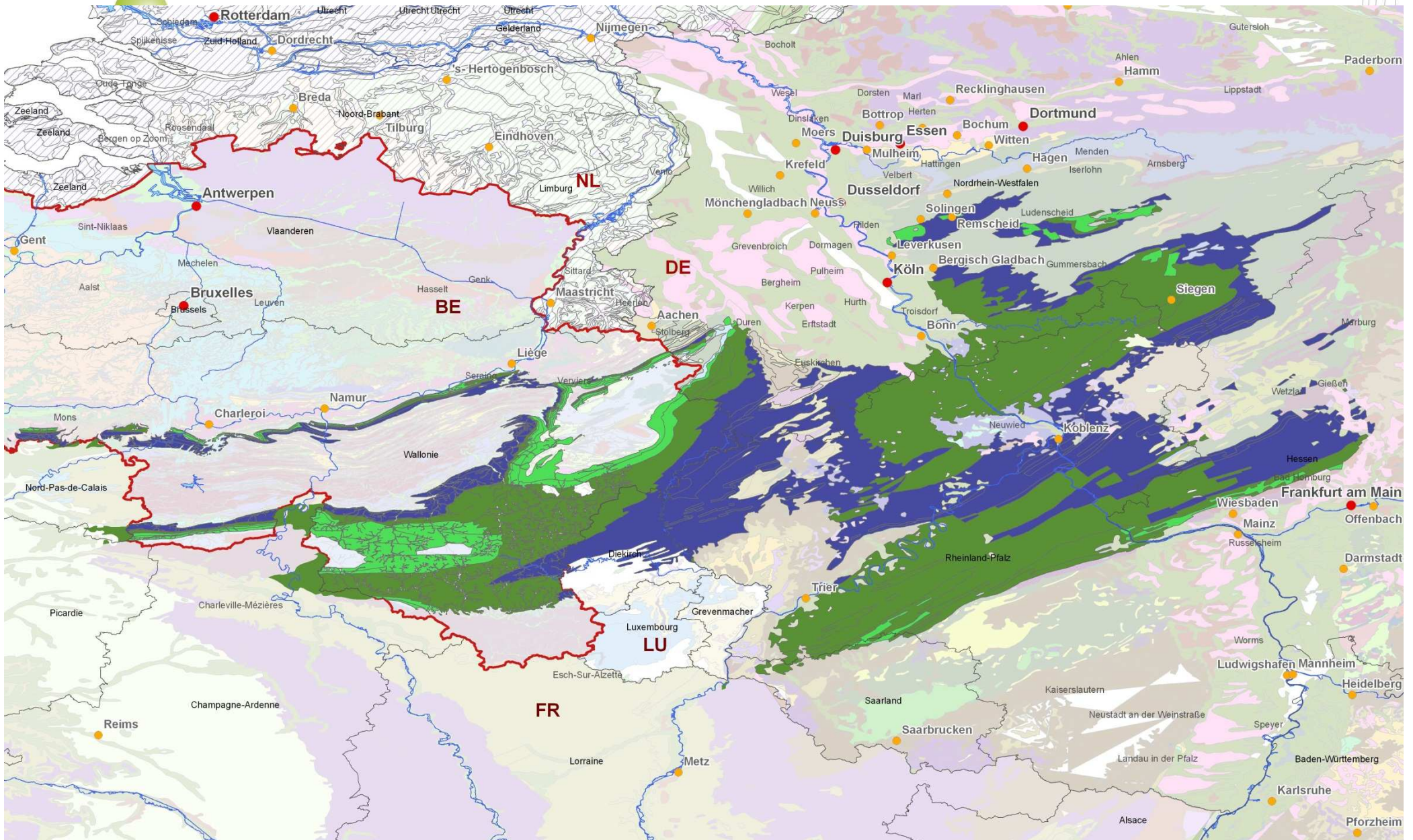
BE_surfaceGroupRadon

Radon Potential

-  8,95 - 11
-  14 - 10
-  17,12 - 4
-  17,5 - 9
-  19,8 - 8
-  20,6 - 7
-  22,12 - 6
-  25,3 - 5
-  39,84 - 2
-  40,31 - 3
-  41,47 - 1

Kilometers
0 5 10 20







CONCLUSIONS

- The classified geological units, characterized by their overall indoor and soilgas characteristics, will be used to map the local variations of radon potential and indoor radon risk
 - Cross-border variations have to be analysed in detail:
 - Germany
 - Luxemburg
 - (France)
 - Available parameters are currently being introduced into the JRC radon protocol
- 