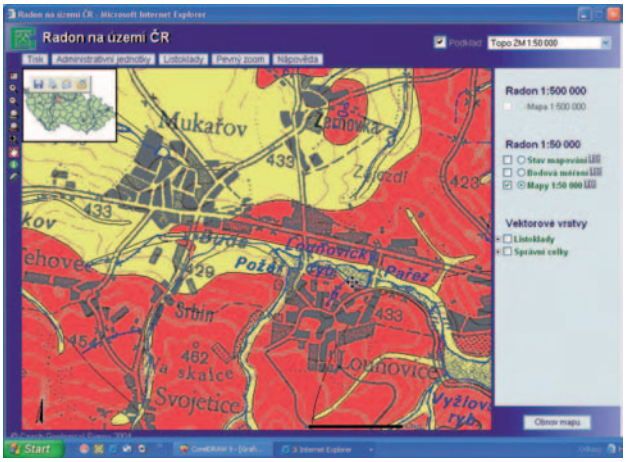


Fig.7-11. Zoomed section of radon index map, raster topography added. For local authorities this information enables to distribute the indoor radon detectors into high risk parts of municipalities with an enhanced efficiency.

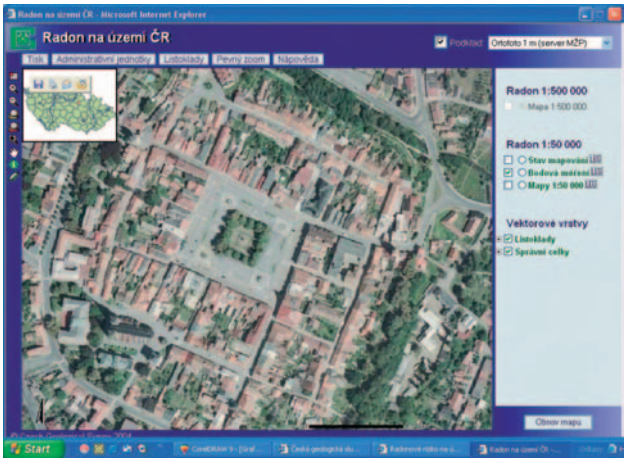


Fig. 7-12. The same frame with the ortophoto image background (1 m resolution) and information window on the selected test site. Administrative borders can be also added.

experience shows the customers' interest usually in a certain areas of the intended building activities. However the warning of not substituting the building site assessment by using the radon index map information is emphasized (Barnet – Pacherová – Neznal 2005).

The CD-ROM was also applied as a part of web pages oriented to radon problematics and radon programme. The web pages comprise the general information on sources of radon in bedrock, methods used for radon index determination, mapping programme within the Czech Republic, comparison of indoor and soil gas radon measurements, publication list and usefull links to radon pages of institutions involved in the Radon Programme of the Czech Republic and in some European countries. The radon web pages address is www.geology.cz in Czech and English version (http://nts2.cgu.cz/servlet/page?_pageid=350,366,352&_dad=portal30&_schema=PORTAL30).

The third internet application of radon index maps is located on the Map Server of the Czech Geological Survey (Figs 7-9 to 7-12). This application enables the continuos moving between the adjacent map sheets and linked general topography, raster topography at a scale 1 : 50 000, detailed topography at a scale 1 : 25 000 after the military mapping at in a close zooming the photogrammetric images with 1 m resolution.The basic information on the measurement points is also added.

8. Statistics of radon in the rock types

The geological situation of the area is the main factor influencing the resulting radon index of the building site. The determination of the radon index is based on two factors: soil gas radon concentration and the permeability of soil and rock for gasses (Neznal et al. 2004).

The statistical parameters of the radon distribution were calculated for the main rock types of the Czech Republic using the radon database of the Czech Geological Survey and the Arc Gis projection. The database consists of the data from the radon measurements performed on the area of the Czech Republic including the location data, the levels of volume radon activity and the resulting radon risk category.

The magmatic rocks have the highest both mean volume radon activity (51.4 kBq . m^{-3}) and percentage share of high radon risk index (37 %). Little bit smaller are the values of metamorphic rocks (mean soil gas radon is 33.7 kBq . m^{-3}, percentage share of high radon index is 16 %) and the minimal values have the sedimentary rocks (22.6 kBq . m^{-3}, 4 % of high radon risk category). The distribution of low, medium and high radon risk index, the categories of the permeability and the values of mean and median soil gas radon concentrations (kBq . m^{-3}) for magmatites, metamorphites and sediments are mentioned in Tab. 8-1. The portion of the extreme measurements shows the same trend when 12.3 % of all measurements performed on the magmatic rocks are higher than 100 kBq . m^{-3}, 4% in the case of metamorphic rocks and only 1.1 % in the case of sedimentary rocks. The distribution of mean soil gas radon concentrations, the categories of radon index and the permeability of magmatic, metamorphic and sedimentary rocks is shown in Fig. 8-1.

The mean and median values of mean soil gas radon concentrations and the distribution of low, medium and high radon risk category are listed in Tab. 2. Whereas the trend of growing mean soil gas radon concentrations of sedimentary, metamorphic and magmatic rocks, there are the differences in mean soil gas radon concentrations of different types of all three kinds of rocks. The relatively high values of Carboniferous sediments and Palaeozoic formations in general can be caused by the presence of uranium mineralization connected with the bitumenous sediments. The highest differences of radon concentrations show the magmatic rocks. The highest both mean volume radon activity and the distribution of high radon index have the syenites and durbachites (mean soil gas radon concen-

Tab. 8-1. The distribution of low, medium and high radon risk index and permeability (%) and the mean and median soil gas radon concentrations (kBq . m^{-3}) for magmatites, metamorphites and sediments

	Radon risk category (%)			Soil gas permeability (%)			Soil gas radon ^{222}Rn		
	1	2	3	1	2	3	Count	Mean	Median
Magmatites	20	43	37	17	59	24	1291	51.4	32.2
Metamorphites	30	54	16	16	65	19	1812	33.7	23.8
Sediments	50	46	4	35	54	44	5101	22.6	16.9

Tab. 8-2. The distribution of low, medium and high radon risk index and the category of the permeability (%) and the mean and median values of mean soil gas radon concentrations (kBq . m^{-3})

	Radon risk category (%)			Soil gas permeability (%)			Soil gas radon ^{222}Rn		
	1	2	3	1	2	3	Count	Mean	Median
Diorites and gabbros	36	55	9	30	56	14	44	21.6	18
Mesozoic sediments	56	42	2	29	55	16	987	18.3	14.9
Mesozoicum: Alpine folded	81	19	-	51	42	7	226	16.9	15.6
Moldanubicum Monotonous Group	34	50	16	11	68	21	472	30.8	21.6
Moldanubicum Varied Group	32	57	11	15	67	18	252	30.1	22.7
Orthogneisses, granulites and migmatites	31	45	24	15	64	21	224	37.6	22.4
Paleozoic folded metamorphosed	15	62	23	9	72	19	145	49.2	30.8
Paleozoic folded unmetamorphosed	35	53	12	21	67	12	732	30.7	20.2
Permocarboniferous sediments	29	65	6	24	62	14	297	28.3	22
Prevariscan granitoids	36	59	5	31	56	13	141	19.9	15.7
Proterozoic-Palaeozoic volcanites	39	51	10	20	61	19	172	28.5	21.7
Proterozoic-Prevariscan metamorphites	30	56	14	21	62	17	719	32.5	23.5
Quaternary sediments	54	43	3	40	43	17	2259	21.6	16.2
Syenites and durbachites	6	24	70	17	59	24	153	100	74.5
Tertiary sediments	35	57	8	35	57	8	356	25.7	19
Tertiary sediments: Alpine folded	58	41	1	48	47	5	244	17.4	15.4
Tertiary volcanites	56	38	6	36	48	16	69	21.1	16.2
Variscan granites	10	39	51	11	59	30	379	63	44.9
Variscan granodiorites and tonalites	14	43	43	11	62	27	333	51.4	37.5

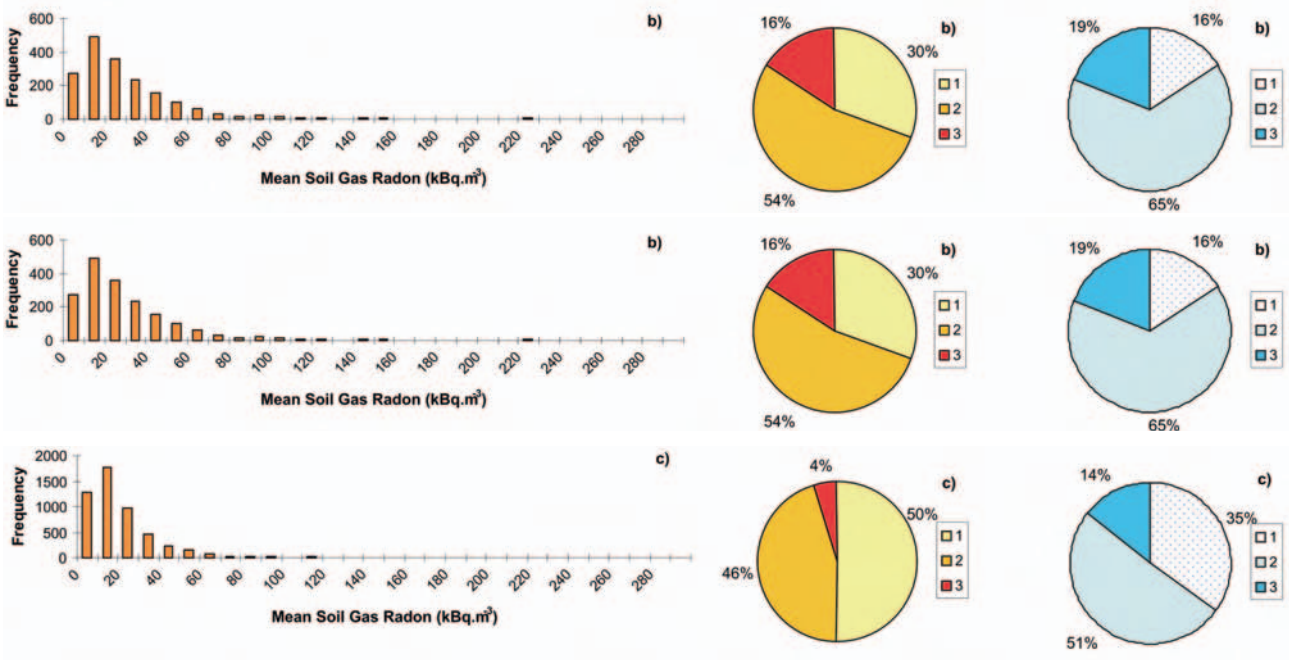


Fig. 8-1. The distribution of mean soil gas radon concentrations (kBq . m^{-3}), the radon index (first column of pie graphs) and the permeability (second column of pie graphs) of magmatic (a), metamorphic (b) and sedimentary (c) rocks.

tration 100 kBq . m^{-3}, 70% of high radon index), Variscan granites (mean radon concentration 63 kBq . m^{-3}, 51% of high radon index) and granodiorites and tonalities (mean soil gas radon 51 kBq . m^{-3}, 43% of high radon index). The summary of the basic statistical parameters of mean soil gas radon concentrations of magmatic, metamorphosed and sedimentary rocks is listed in Tables 8-3, 4 and 5 and the distribution od low, mediate and high radon index and permeability are shown in Figs 3,5 and 7. The geological situation is showed in Figs 8-2, 4 and 6.

8.1. MAGMATIC AND VOLCANIC ROCKS

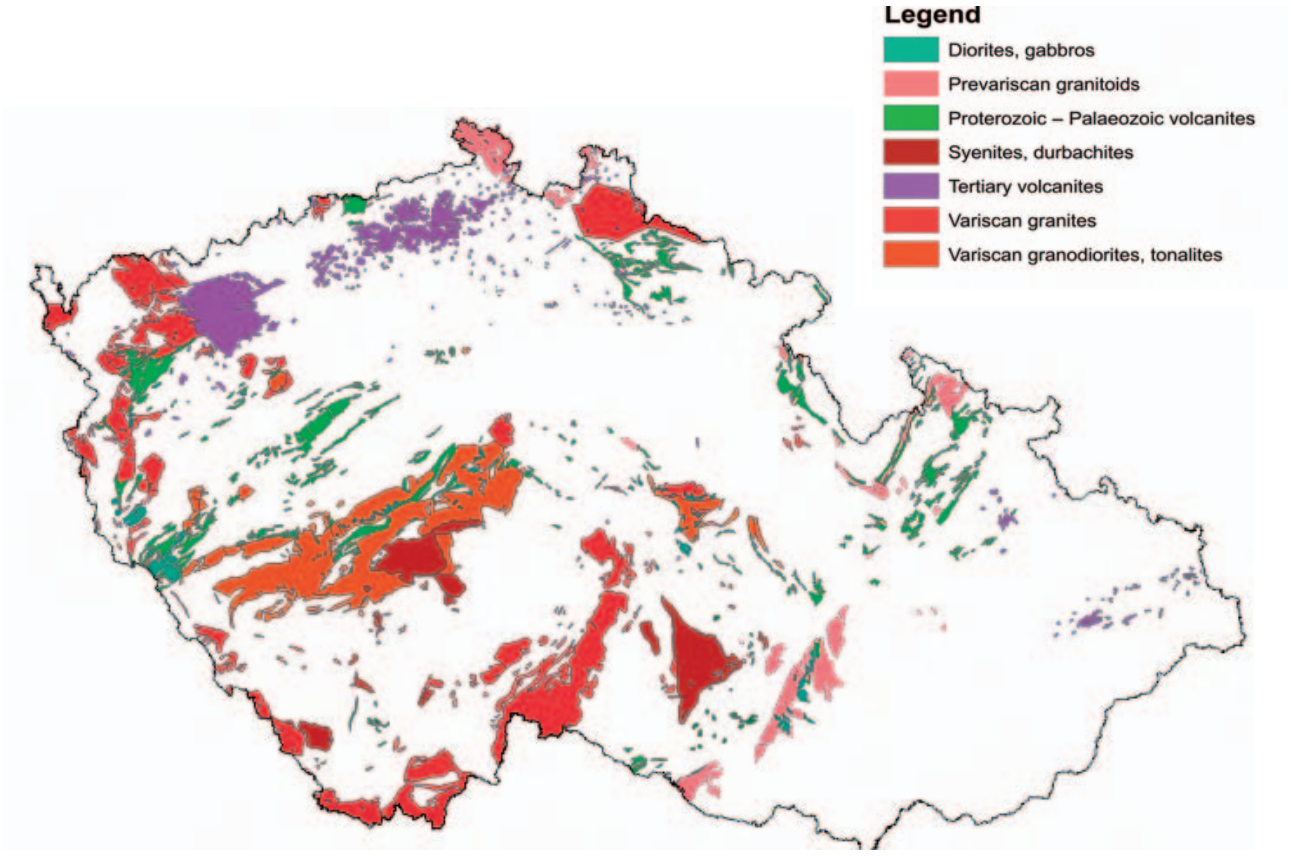


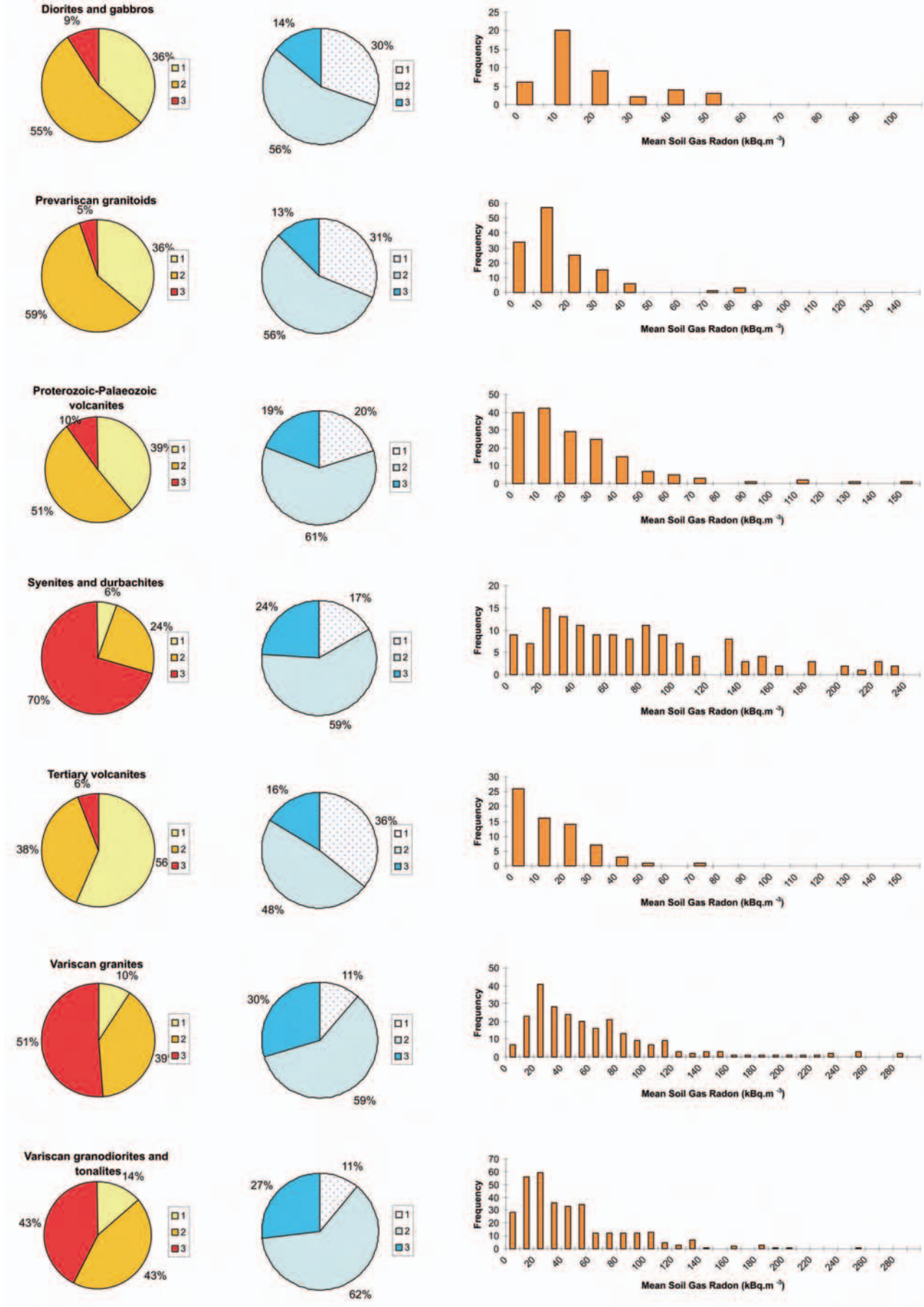
Fig. 8-2. The map of the position of magmatites in the Czech Republic.

Tab. 8-3. The basic statistical parameters of mean soil gas radon concentrations (kBq . m^{-3}) of magmatic rocks

	Diorites and gabbros	Prevariscan granitoids	Proterozoic – Palaeozoic volcanites	Syenites and durbachites	Tertiary volcanites	Variscan granites	Variscan granodiorites and tonalites
Mean value	21.60	19.91	28.51	99.99	21.14	63.02	51,35
Error of mean value	2,13	1,26	2,19	7,43	3,11	2.91	3.05
Median	18.00	15.70	21.70	74.50	16.20	44.90	37.50
1. Quartile	11.95	10.10	10.93	36.10	6.90	25.40	20.00
3. Quartile	26.43	24.30	37.10	131.00	26.00	79.00	63.90
Maximum	56.00	86.80	233.80	464.50	197.20	303.00	582.50
Standard deviation	14.11	14.99	28.72	91.88	25.82	56.72	55.66
Kurtosis	0.43	7.37	17.81	2.86	32.04	4.70	39.56
Skewness	1.09	2.36	3.41	1.71	4.94	2.06	4.98

⟶

Fig. 8-3. The distribution of radon index (first column of pie graphs), the permeability (second column of pie graphs) and mean soil gas radon concentrations (kBq . m^{-3}) of magmatites.


Diorites and gabbros
9%
36%
55%
1
2
3
14%
30%
56%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)
Prevariscan granitoids
5%
36%
59%
1
2
3
13%
31%
56%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)
Proterozoic-Palaeozoic volcanites
10%
39%
51%
1
2
3
19%
20%
61%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)
Syenites and durbachites
6%
24%
70%
1
2
3
24%
17%
59%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)
Tertiary volcanites
6%
38%
56
1
2
3
16%
36%
48%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)
Variscan granites
10%
51%
39
1
2
3
30%
11%
59%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)
Variscan granodiorites and tonalites
14%
43%
43%
1
2
3
27%
11%
62%
1
2
3
Frequency
Mean Soil Gas Radon (kBq.m -3)

8.2. METAMORPHIC ROCKS

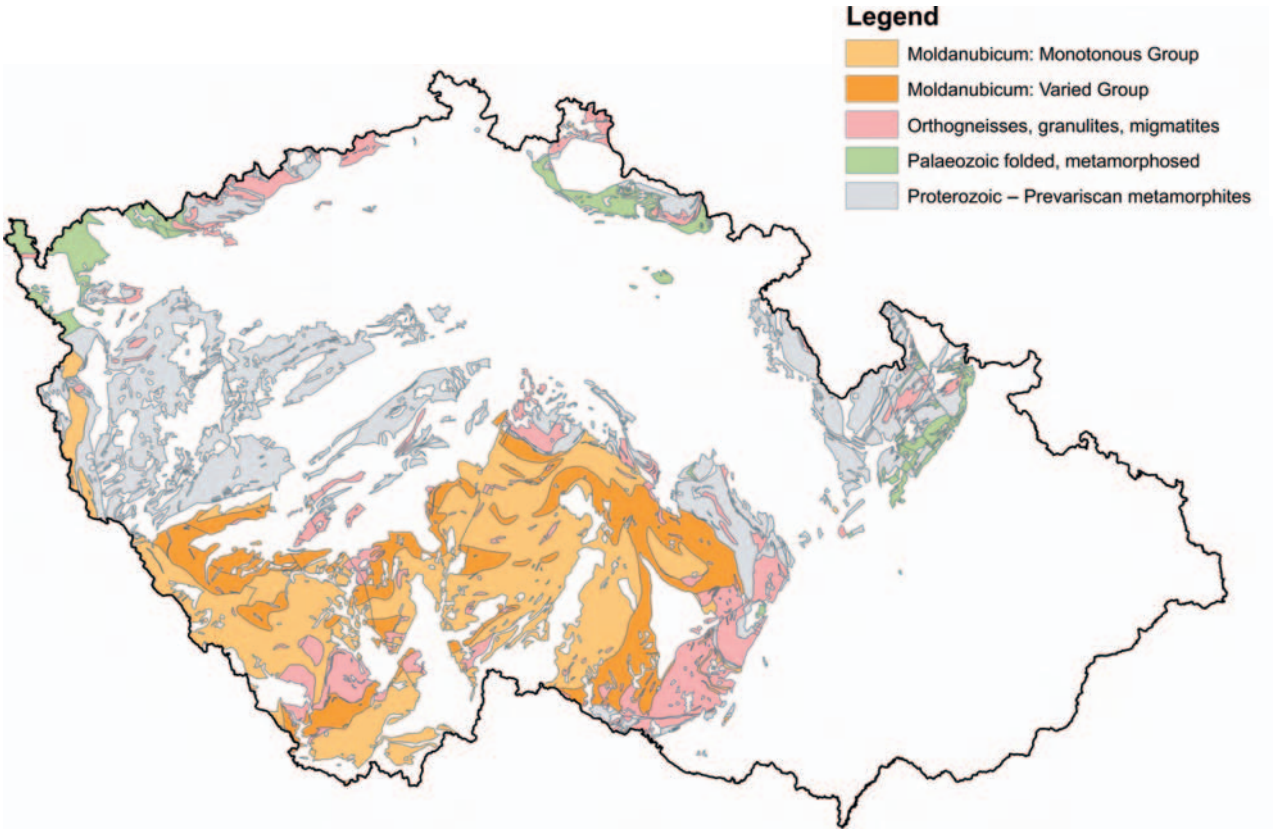


Fig. 8-4. The map of the position of metamorphites in the Czech Republic.

Tab. 8-4. The basic statistical parameters of mean soil gas radon concentrations (kBq . m^{-3}) of metamorphosed rocks

	Moldanubicum: Monotonous Group	**Moldanubicum: Varied Group**	**Orthogneisses**	**Palaeozoic folded, metamorphosed**	**Proterozoic-Prevariscan metamorphites**
Mean value	30.84	30.10	37.56	49.17	32.51
Error of mean value	1.36	2.72	2.94	4.59	2.00
Median	21.90	22.70	22.40	30.80	23.50
1. Quartile	13.65	12.38	12.00	18.00	14.00
3. Quartile	38.78	34.93	45.70	52.00	41.00
Maximum	245.40	558.70	323.90	323.60	1003.60
Standard deviation	29.47	43.19	44.04	55.29	53.50
Kurtosis	14.05	92.41	12.36	8.23	245.51
Skewness	3.08	8.30	3.03	2.73	14.35

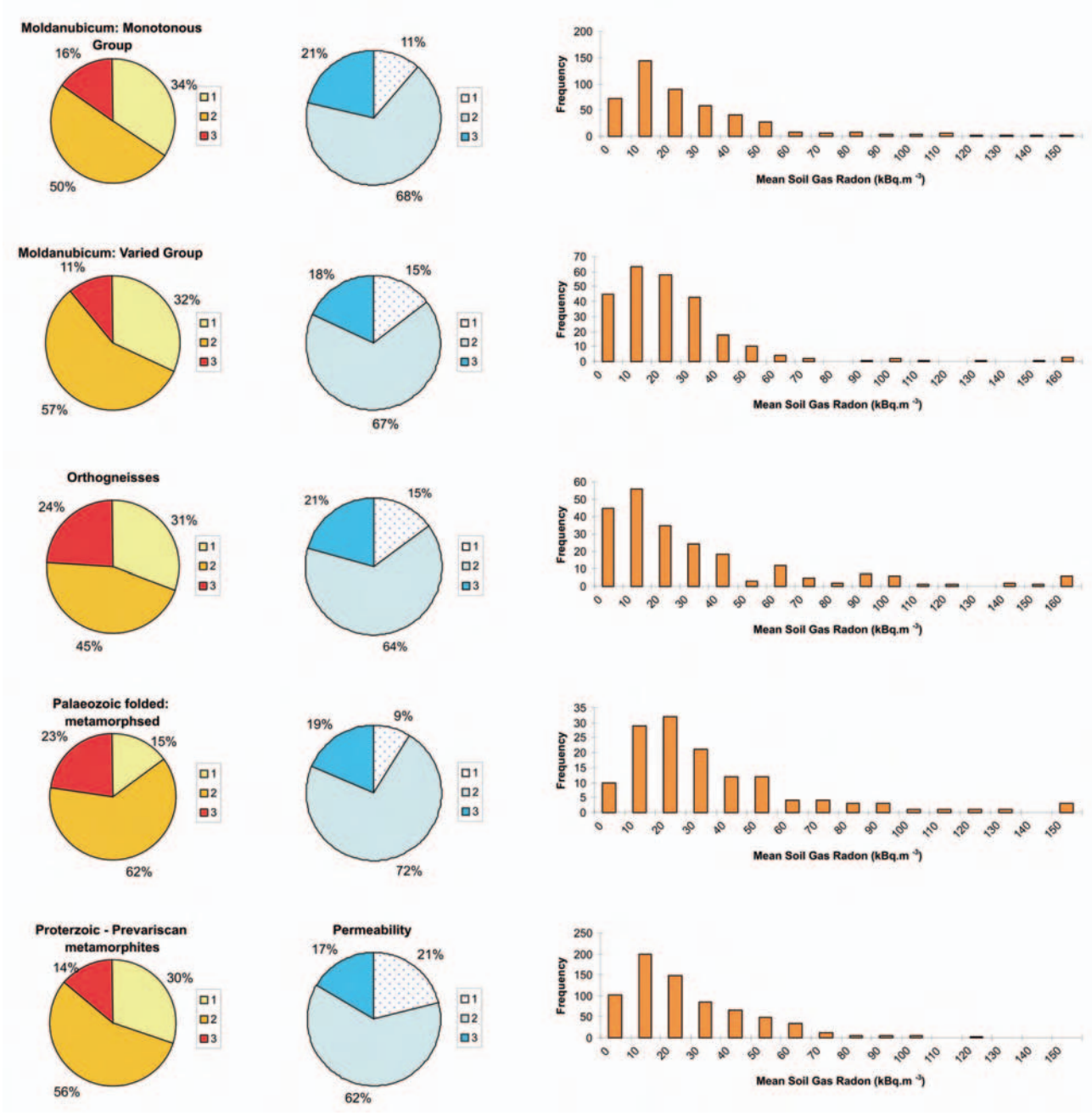


Fig. 8-5. The distribution of radon index (first column of pie graphs), the permeability (second column of pie graphs) and mean soil gas radon concentrations (kBq . m^{-3}) of metamorphosed rocks.

8.3. SEDIMENTARY ROCKS

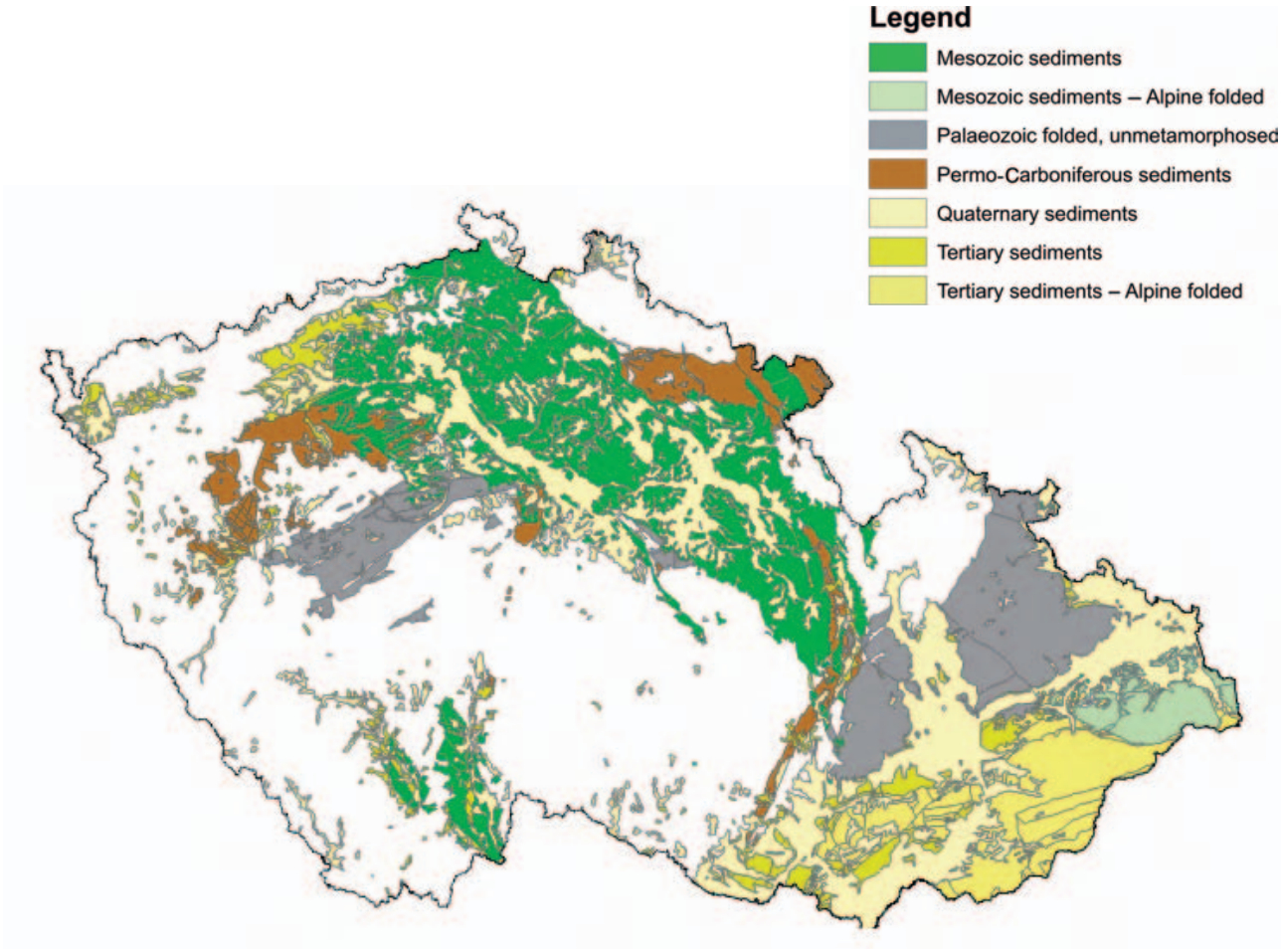


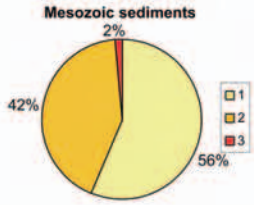
Fig. 8-6. The map of the position of sediments in the Czech Republic.

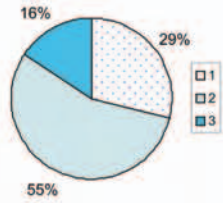
Tab. 8-5. The basic statistical parameters of mean soil gas radon concentrations (kBq . m^{-3}) of sedimentary rocks

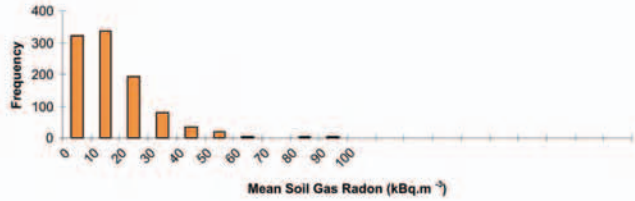
	Mesozoic sediments	Mesozoic sediments: Alpine folded	Palaeozoic folded, unmetamor.	Permo-Carbon. sediments	Quaternary sediments	Tertiary sediments	Tertiary sediments: Alpine folded
Mean value	18.33	16.94	30.75	28.34	21.62	25.68	17.42
Error of mean value	0.49	0.66	1.42	1.35	0.81	1.26	0.71
Median	14.90	15.60	20.20	22.00	16.20	19.00	15.40
1. Quartile	8.20	9.78	12.00	13.60	9.90	12.00	10.00
3. Quartile	23.15	22.18	36.52	34.60	26.40	31.00	22.00
Maximum	192.50	72.40	635.10	213.80	1633.90	236.00	55.90
Standard deviation	15.30	9.86	38.41	23.29	38.40	23.72	11.12
Kurtosis	26.21	3.91	96.02	14.96	1378.96	21.61	1.26
Skewness	3.59	1.33	7.51	2.87	33.21	3.61	1.13

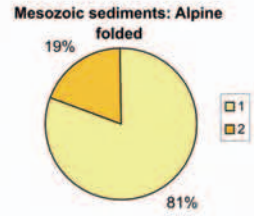
→

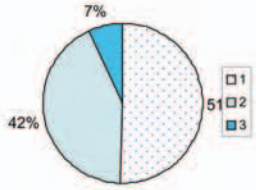
Fig. 8-7. The distribution of radon index (first column of pie graphs), the permeability (second column of pie graphs) and mean soil gas radon concentrations (kBq . m^{-3}) of sedimentary rocks.

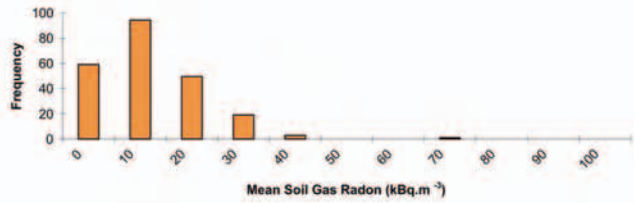

Mesozoic sediments
2%
42%
56%
1
2
3

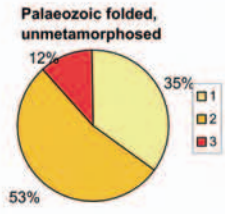

16%
29%
55%
1
2
3

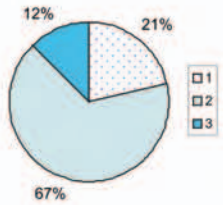

Frequency
Mean Soil Gas Radon (kBq.m -3)

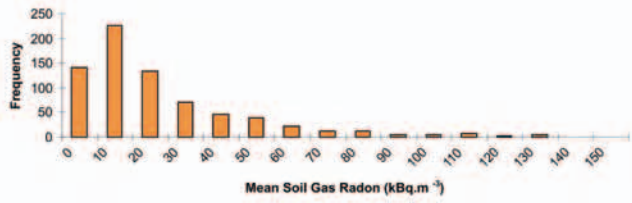

Mesozoic sediments: Alpine folded
19%
81%
1
2

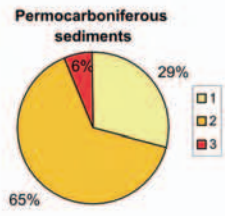

7%
42%
1
2
3

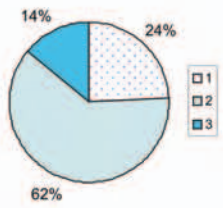

Frequency
Mean Soil Gas Radon (kBq.m -3)

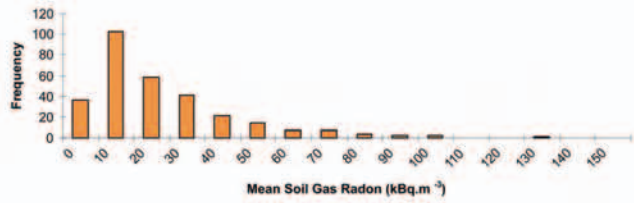

Palaeozoic folded, unmetamorphosed
12%
35%
53%
1
2
3

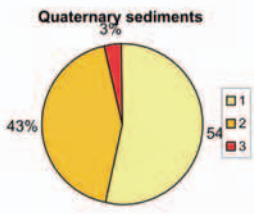

12%
21%
67%
1
2
3

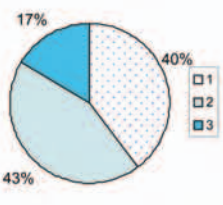

Frequency
Mean Soil Gas Radon (kBq.m -3)

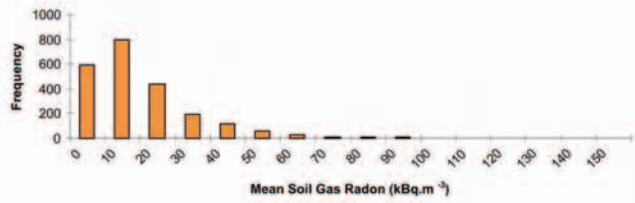

Permocarboniferous sediments
6%
29%
65%
1
2
3

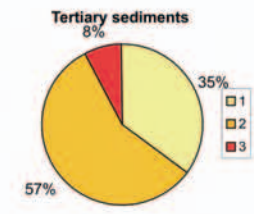

14%
24%
62%
1
2
3

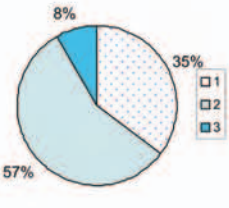

Frequency
Mean Soil Gas Radon (kBq.m -3)

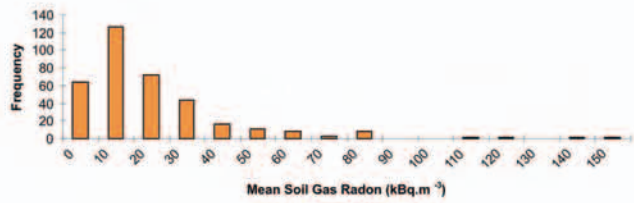

Quaternary sediments
3%
43%
54
1
2
3

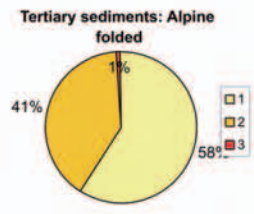

17%
40%
43%
1
2
3

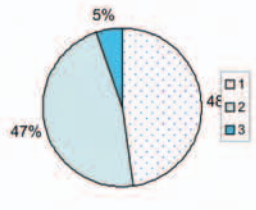

Frequency
Mean Soil Gas Radon (kBq.m -3)

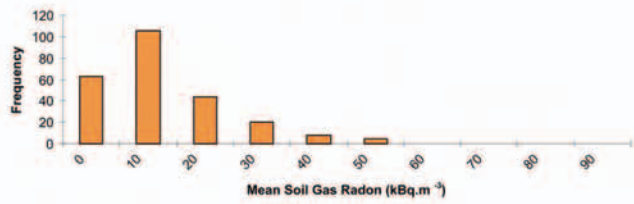

Tertiary sediments
8%
35%
57%
1
2
3


8%
35%
57%
1
2
3


Frequency
Mean Soil Gas Radon (kBq.m -3)


Tertiary sediments: Alpine folded
1%
41%
1
2
3


5%
47%
1
2
3


Frequency
Mean Soil Gas Radon (kBq.m -3)