Radon mapping in Azerbaijan

Ch. S. Aliyev, A. A. Feyzullayev, F. F. Veliyeva, R. J. Baghirli

Geology Institute of Azerbaijan National Academy of Sciences **GIA**

*L. Pampuri, M. Hoffmann, C. Valsangiacomo*

Radon Competence Centre (**RCC**) University of Applied Sciences of Southern Switzerland (**SUPSI**)

About the project

- The studies of radon concentration in Azerbaijan for the first time carried out in 2010-2011

- Project concluded with financial support of the Swiss National Science Foundation (SNSF) under the grant "Creation of Cadastre and Map of Distribution of Radon in Azerbaijan using the Swiss Methodology and Experience"

- The studies were carried jointly by RCC (SUPSI) and GIA

Risks of Radon

- In 1990 EPA (United States Environmental Protection Agency) placed indoor air pollution at the top of the list of 18 sources of cancer risk

- Indoor pollution is rated by risk analysis scientists as high-risk health problem for humans

- Radon is one of the three most dangerous indoor air pollutants, along with cigarette smoke and formaldehyde

- Radon is the second leading cause of lung cancer, after smoking
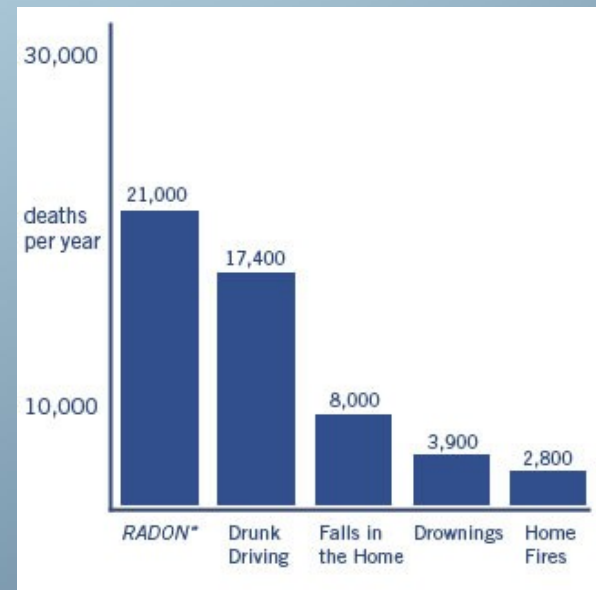
Health effects of radon

- Even very small exposures to radon can result in lung cancer

- No threshold below which levels are harmless

- Many smokers will get lung cancer because of the synergy between radon and cigarette smoking

- Epidemiological studies (miners) and animal studies support evidence of radon as a cause of lung cancer

- The BEIR ("Biological Effects of Ionizing Radiation") VI Report of the National Academy of Sciences, the most comprehensive study to date, supports that conclusion
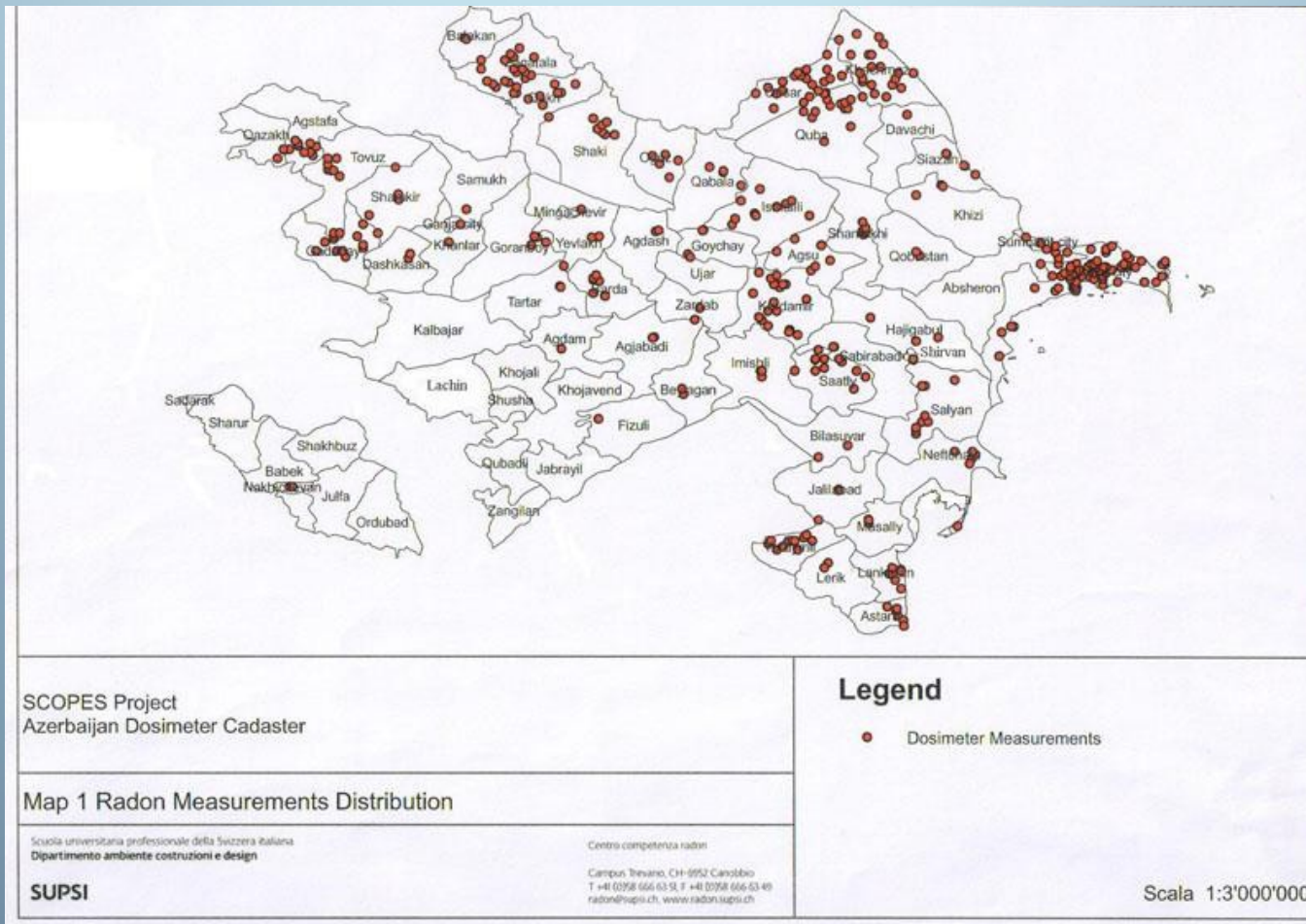
Geological radon situation in Azerbaijan

- located in depression zones (average -28m below sea level)

- surface of depression is covered by young Quaternary (2.588 ± 0.005 million years ago) deposits with a generally low content of radio nuclides meanwhile higher radioactivity in surrounding mountain areas (older)

- active tectonic dislocations (mostly earthquakes, active mud volcanoes) contribute to fluid emission into the surface, including radon
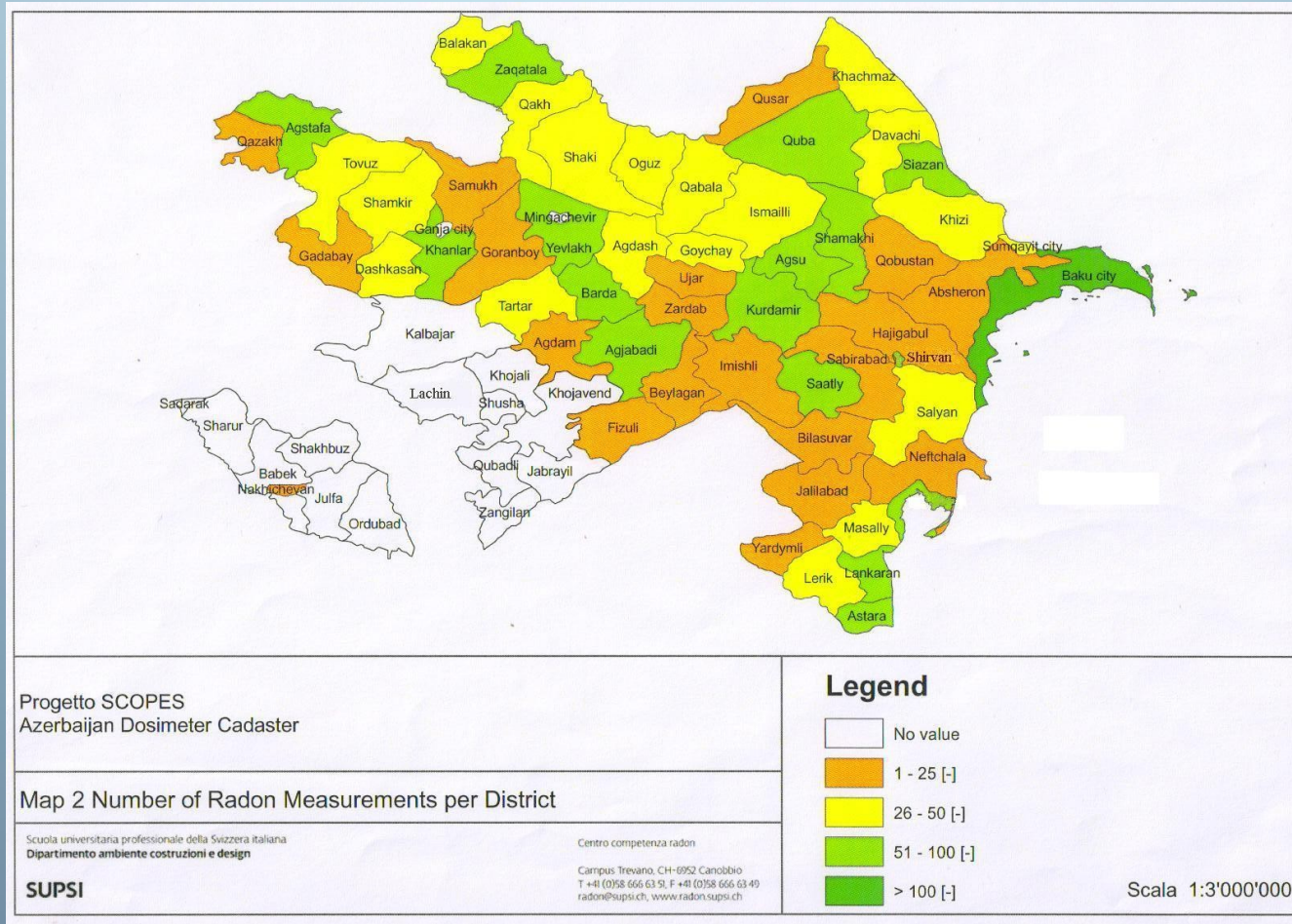
Objective and methods of studies

- The main goal of the project was the creation of an indoor radon cadastre in Azerbaijan

- 2500 radon Gammadata dosimeters were provided to the Geology Institute of Azerbaijan National Academy of Sciences with the support of SNSF and SUPSI

- Dosimeters were placed mainly in residential buildings and in some industrial buildings in different regions of the country from November to December 2010. Exposure time was not longer than 2 months

- When the detectors were placed, specially prepared data sheets were compiled with the following data: code of instrument, time of installation and removal, address, GPS coordinates and building type (material), etc...

# Scheme of distribution of the radon measurements points

SCOPES Project
Azerbaijan Dosimeter Cadaster

Map 1 Radon Measurements Distribution

Legend

• Dosimeter Measurements

Scuola universitaria professionale della Svizzera italiana
Dipartimento ambiente costruzioni e design

SUPSI

Centro competenza radon

Campus Trevano, CH-6952 Canobbio
T +41 00958 666 63 51, F +41 00958 666 63 49
radon@supsi.ch, www.radon.supsi.ch

Scala 1:3'000'000

Number of the radon measurements points for per District

Map 2 Number of Radon Measurements per District

Results of investigations

- Obtained data were processed by using mathematical statistics methods

- Out of the 2407 measured houses 169 were above 200 Bq/m^3 and 418 houses are between 100 and 200 Bq/m^3

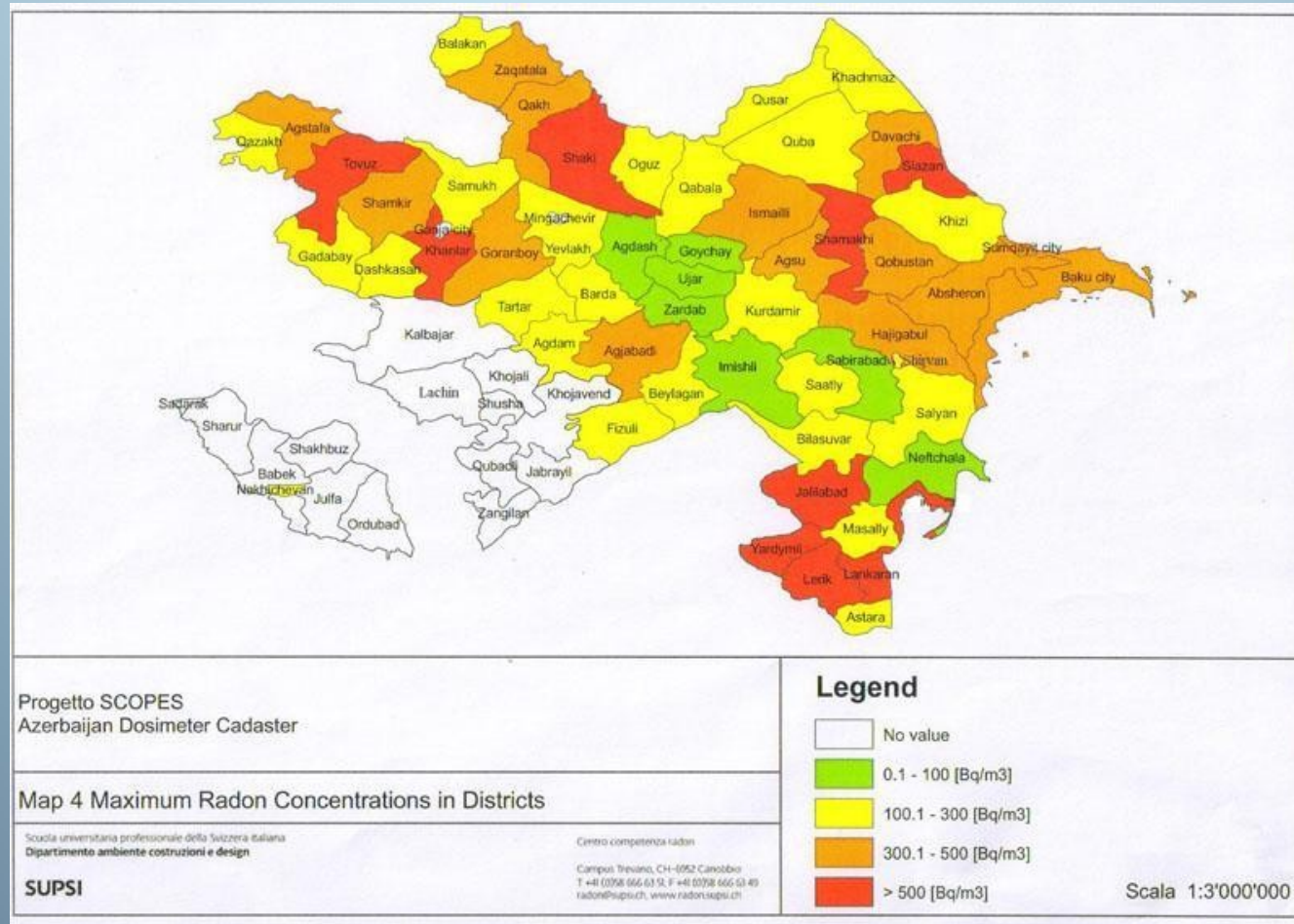- The maximum allowable concentration for radon in Azerbaijan is 200 Bq/m^3
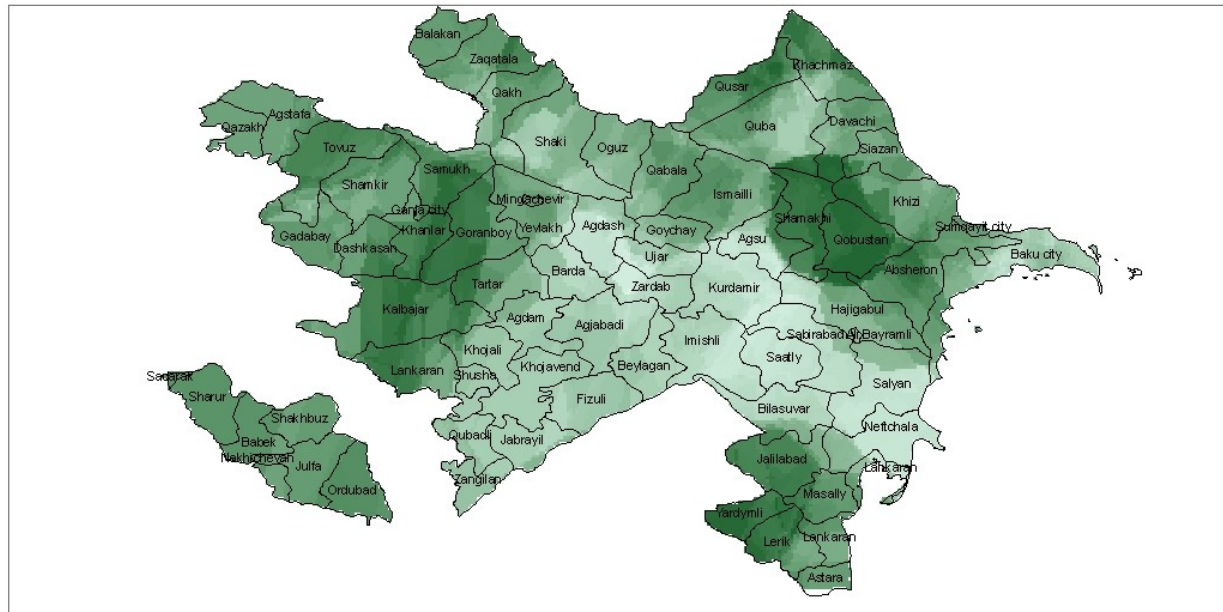
Histogram of distribution of radon concentrations
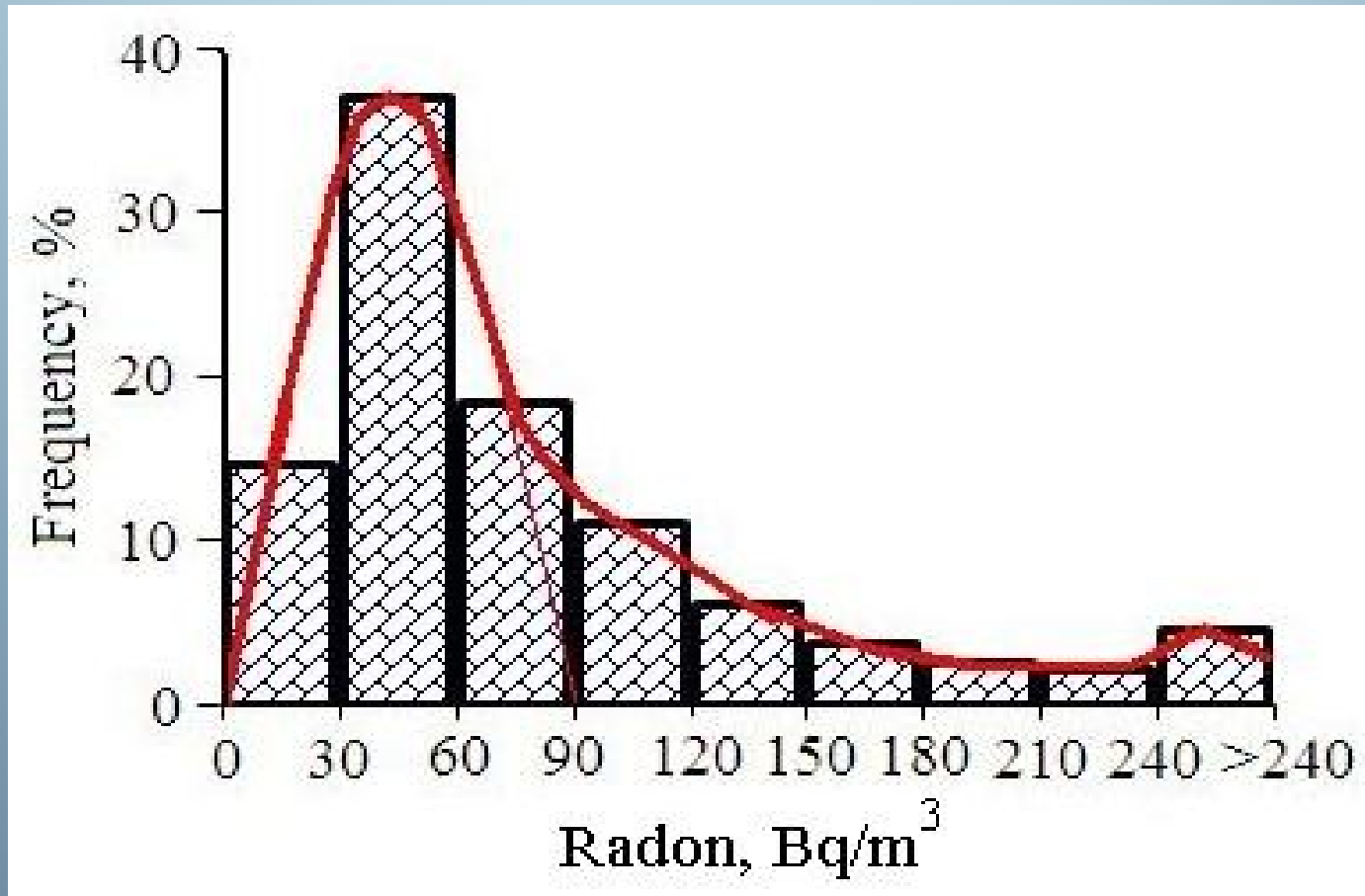
Mean radon concentration for different districts

Map 3 Mean Radon Concentrations in Districts
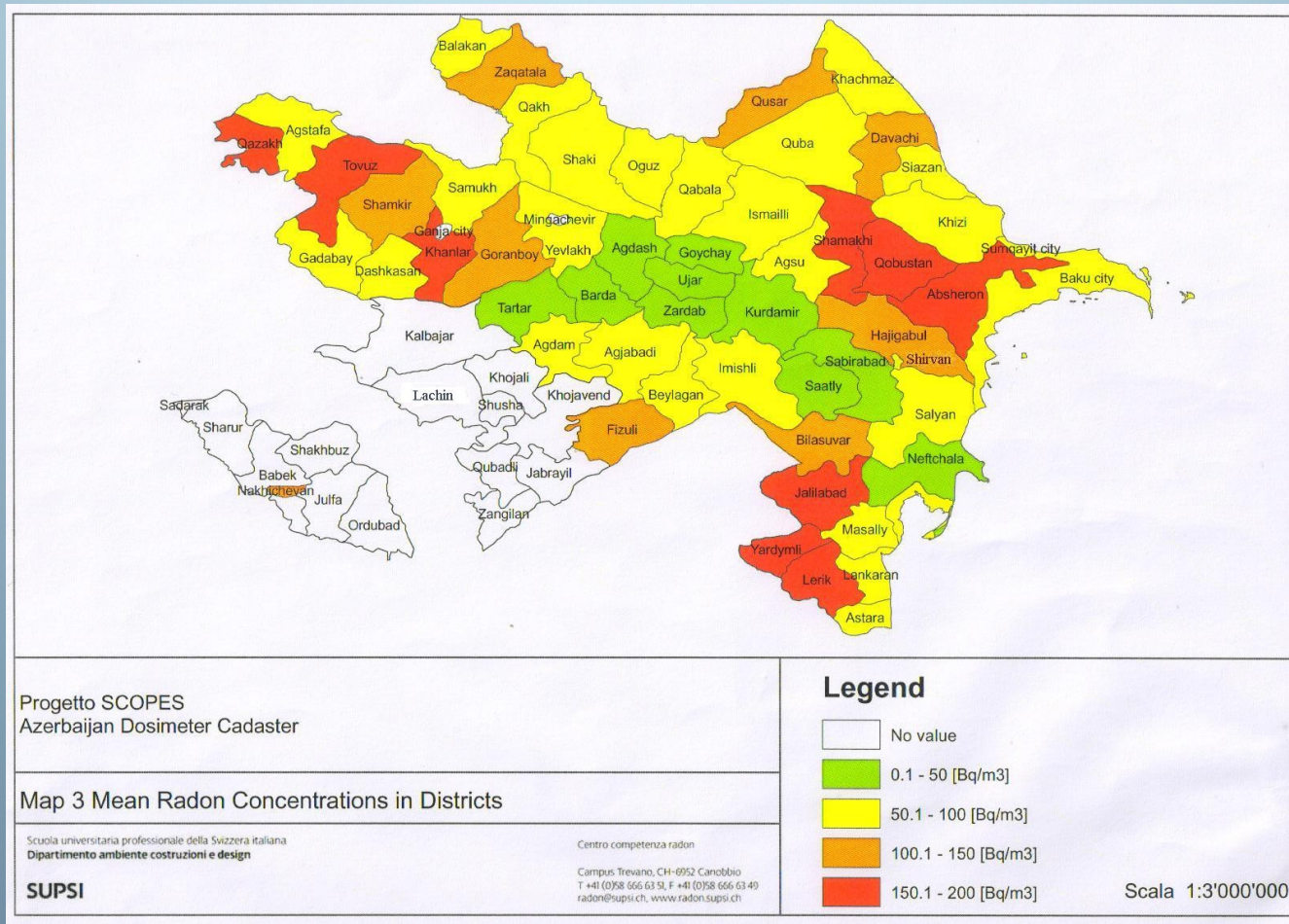
Maximum radon concentrations for different districts

Radon concentration interpolation (Kriging)

Map of distribution of volumetric activity [Bq/m³] of radon in Azerbaijan
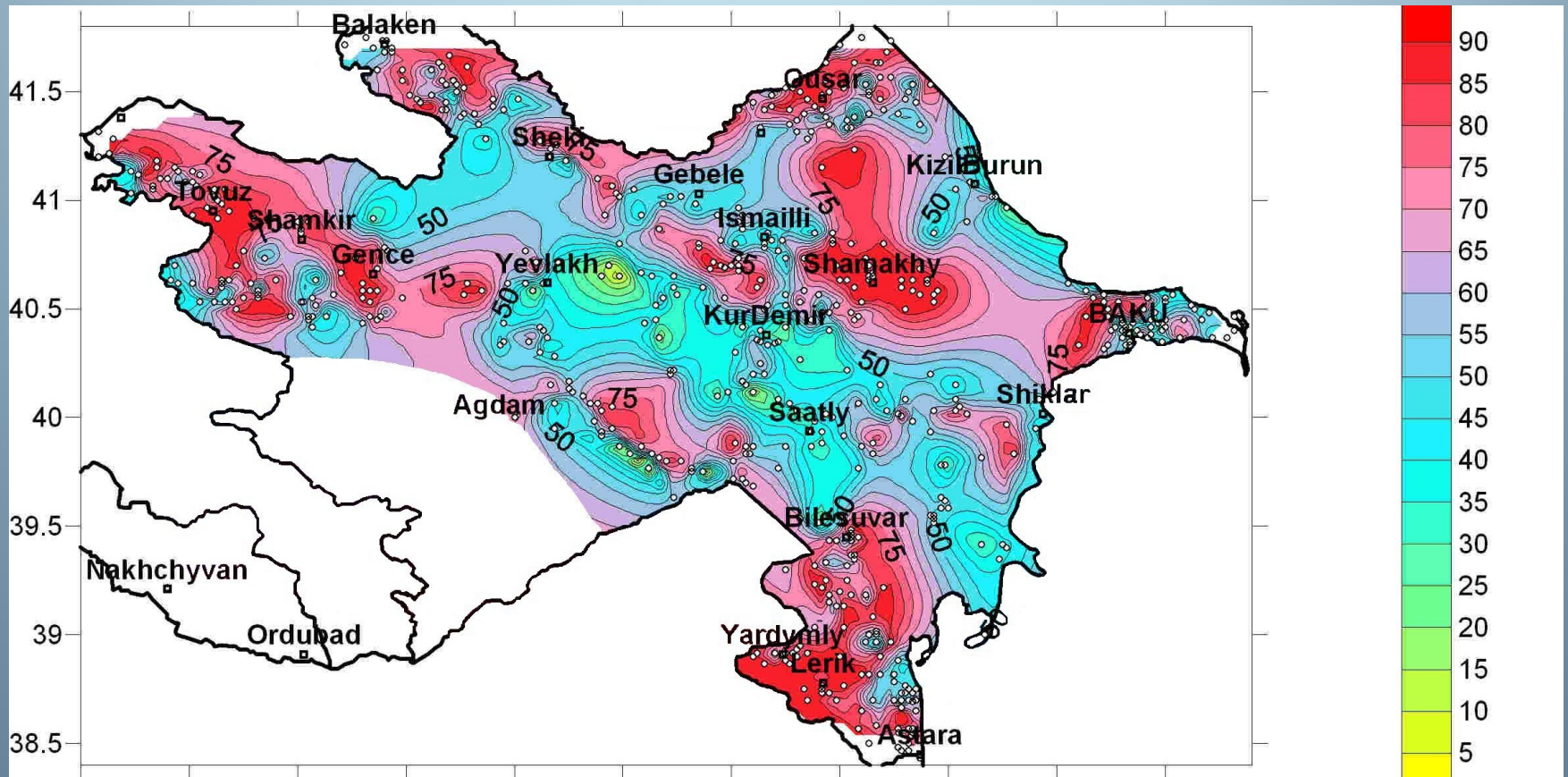
Map of anomalous concentrations of radon in Azerbaijan

Obtained results

The analysis of provided maps shows:

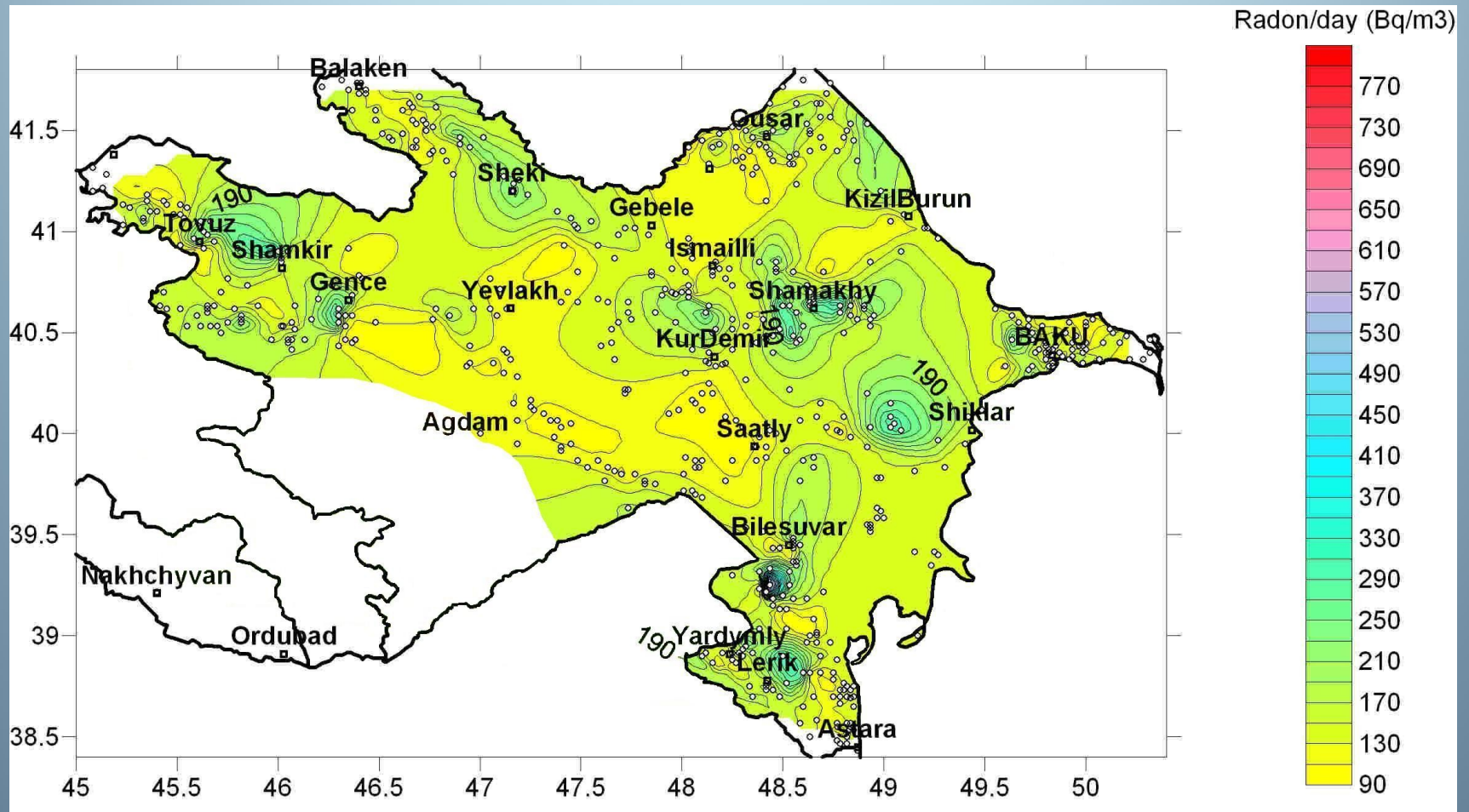• spatial distribution of radon is heterogeneous and mosaic

• the areas with the highest concentrations are confined to mountainous and folded massifs of Great and Small Caucasus and Talysh mountains and the lowest concentrations are confined to lowland areas

• based on this, it is possible to suggest that high concentrations are associated with relatively ancient rock

Map of comparison of radon field of Azerbaijan with deep faults and epicenters of sensible earthquakes
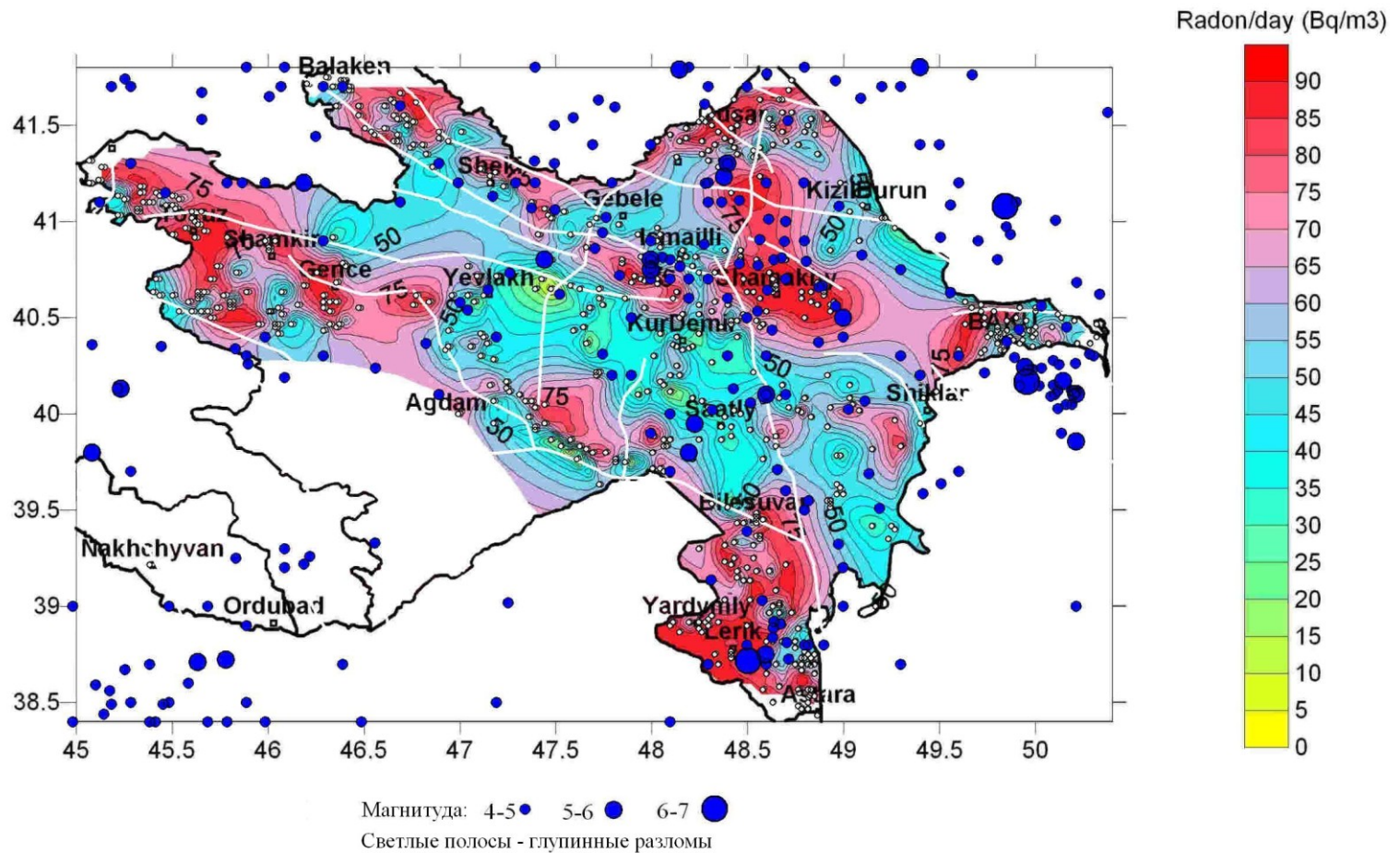
Distribution of radon depending on the building material

Construction type	Quantity	Percent	Radon, Bq/m^3		
			Maximum	Minimum	Mean
Timber house	14	0,75	216	32	75
River rocks	328	15,4	834	21	104
Natural stone	20	0,95	664	20	153
Limestone	1308	61,5	1014	16	85
Concrete	35	1,6	253	21	56
Brick	421	19,8	1109	17	94

Table 3

Radon concentration at different floors in buildings

Floor	Quantity	Percent	Radon, Bq/m^3		
			Maximum	Minimum	Mean
<1	9	0,5	176	29	62
1	1480	77,1	1109	17	95
2	408	21,3	547	16	73
>2	22	1,1	68	3	23

Building year and radon concentration

Building year	Quantity	Percent	Radon, Bq/m^3		
			Maximum	Minimum	Mean
To 1930	134	6,8	279	21	73
1931-1950	137	6,95	664	22	98
1951-1970	569	28,9	734	17	94
1971-1990	740	37,6	1109	16	93
1991-2011	389	19,75	834	21	83

Conclusions

- the first map of volumetric radon concentrations in Azerbaijan was carried out

- the highest radon activity is confined to the areas of intersection of deep active faults

- mosaic association of radon anomalies with seismically active zones of the south slope of Great Caucasus and south side of Lesser Caucasus and its junction with the Kura Depression is observed

The Planned Work Items for future

- analysis of the relation between the level of lung cancer among population and distribution of radon, jointly with regional organizations of the *Ministry of Public Health* of Azerbaijan.

- development and implementation of activities to reduce level of indoor radon (mitigation).

THANK YOU FOR YOUR ATTENTION...