



## **Identification of high radon areas with passive methods and geological assessments in some Italian regions**

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Internationally the indoor radon exposition as health hazard is widely recognized; so in many countries specific laws and regulations and so-called radon - risk maps have been introduced. Few Italian Regions have started surveys for the identification of “radon prone areas”, with independent standards and protocols and this involves a bigger uncertainty on the definition of a national risk map failing guidelines.

In the present work a standardized methodology for indoor radon measurements has been set up by U-Series Srl (Bologna), with attention to the development of a passive measurement technique (solid state nuclear track detectors) on large scale. The developed technique has been validated through an inter-laboratory comparison conducted by the German Federal Office for Radiation Protection (BfS) in 2008 and repeated in 2009.

An indoor radon monitoring survey has been conducted in all Italian Regions with the developed methodology and 5425 measurements have been elaborated to obtain the annual average radon concentration in regional scale and the relapse of seasonal fluctuations on radon concentrations were verified. For the survey, the detectors were installed in underground rooms in workplaces and the measurements were performed over one solar year. As a consequence of our developed methodology (measurements only in underground rooms), indoor radon concentrations resulted generally higher than the concentrations obtained in the National Survey; we estimated an annual mean radon concentration of 110 Bqm<sup>3</sup> compared to 70 Bq/m<sup>3</sup> obtained by the National Survey. Only for the Italian Regions with the largest number of sampling (Lombardia, with the case studies of Milano Province and Milano city, Emilia Romagna, Toscana, Puglia) the data obtained were georeferentiated and we elaborated these data using geostatistical technique in order to produce distribution maps of the annual average indoor radon concentration. We have integrated the elaborated maps with the geological knowledge of the high concentration macro-areas identified in this work in order to better determine them. This study has allowed to point out not negligible radon concentrations also in traditionally no-risk zone; moreover the application of the developed methodology will be useful to give advices in order to fill Italian legislation gaps or to draft urban development plans.

In particular, the correlation between radon concentrations and some geological features has been proved in Lombardia and some hypothesis have been formulated to understand the geological origin of the radon source. The high radon concentrations in the North of the Region are related to the high uranium content in different rock types distributed in these areas. For the flat area in correspondence of the Milan Province and the city of Milan, traditionally considered a no-risk zone, we have done some hypothesis of correlation between radon and the geochemical processes occurred in this area and soil permeability and fracturation by means of the existing geological sections.

The application of the developed methodology will be useful to give advices to fill legislation gaps or to draft urban development plans.