

Exposure to Radon on Air in Tourist Caves in Bulgaria

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Abstract : The carcinogenic effects of radon as a radioactive noble gas have been studied and show a strong correlation between radon exposure and lung cancer occurrence, even in the case of low radon levels. The major part of the natural radiation dose in humans is received by inhaling radon and its progenies, which originates from the decay chain of U-238. Indoor radon poses a substantial threat to human health when build-up occurs in confined spaces such as homes, mines and caves and the risk increases with the duration of radon exposure and is proportional to both the radon concentration and the time of exposure. Tourist caves are a case of special environmental conditions that may be affected by high radon concentration. Tourist caves are a recognized danger in terms of radon exposure to cave workers (guides, employees working in shops built above the cave entrances, etc.), but due to the sensitive nature of the cave environment, high concentrations cannot be easily removed. Forced ventilation of the air in the caves is considered unthinkable due to the possible harmful effects on the microclimate, flora and fauna. The risks to human health posed by exposure to elevated radon levels in caves are not well documented. Various studies around the world often detail very high concentrations of radon in caves and exposure of employees but without a follow-up assessment of the overall impact on human health. This study was developed in the implementation of a national project to assess the potential health effects caused by exposure to elevated levels of radon in buildings with public access under the National Science Fund of Bulgaria, in the framework of grant No KII-06-H23/1/07.12.2018. The purpose of the work is to assess the radon level in Bulgarian caves and the exposure of the visitors and workers. The number of caves (sampling size) was calculated for simple random selection from total available caves 65 (sampling population) are 13 caves with confidence level 95 % and confidence interval (margin of error) approximately 25 %. A measurement of the radon concentration in air at specific locations in caves was done by using CR-39 type nuclear track-etch detectors that were placed by the participants in the research team. Despite the fact that all of the caves were formed in karst rocks, the radon levels were rather different from each other (97-7575 Bq/m³). An assessment of the influence of the orientation of the caves in the earth's surface (horizontal, inclined, vertical) on the radon concentration was performed. Evaluation of health hazards and radon risk exposure causing by inhaling the radon and its daughter products in each surveyed caves was done. Reducing the time spent in the cave has been recommended in order to decrease the exposure of workers.

Keywords : tourist caves, radon concentration, exposure, Bulgaria

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