

# Radon levels in the volcanic region of La Garrotxa, Spain

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## Abstract

A preliminary survey in the city of Olot, the main town of the volcanic region of La Garrotxa, showed that dwellings built on volcanic formations present higher indoor radon levels than dwellings on non-volcanic materials. The soil of the area is not especially rich in radium. However, some of the volcanic materials present very high permeability and therefore radon entering the houses might have travelled over long distances. In this paper we present indoor radon values measured in a larger survey carried out during April–July 2004. The influence of the volcanic materials found in the preliminary survey has been confirmed. The results obtained suggest the possibility that radon comes from the degassing of mantle through active faults. The values obtained in working places do not constitute a relevant radiological risk for workers.

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## 1. Introduction

The unique characteristics of radon (radioactive noble gas) make it very attractive for earth science studies, as it can migrate over significant distances within the earth and the atmosphere, be measured with accuracy, and be used as a tracer for many environmental processes of interest. Many examples of applications on earth sciences can be found in Durrani and Ilić (1997). However, it is also well known that the inhalation of radon progeny indoors is the largest single source of radiation exposure to population (UNSCEAR, 2000). In Spain, according to the 96/29/EURATOM Directive of the European Commission, the regulations of protection against ionizing radiation (Real Decreto 783/2001, 2001) establish for the first time the need of monitoring those working places that might have high radiation levels from natural radionuclides.

In this context, in the period May–September 2002 we carried out a preliminary survey in the city of Olot, the capital of the volcanic-origin region of La Garrotxa, located in the northeast of Spain. The geological structure of Olot consists on a folded Tertiary substratum over which seat recent volcanic formations (between 350,000 and 10,000 years) (Guérin et al., 1986) and sedimentary deposits. In general, volcanoes are made of pyroclastic deposits, and valleys are covered with lava flows. Somewhere the volcanic materials are alternated with lake deposits because lava flows caused the formation of natural dams and sediments filled them too. Pyroclastic materials have intergranular-origin permeability and lava flows have fissure-origin permeability whereas lake deposits and tertiary substratum have a small permeability. In this preliminary survey a total number of 21 dosimeters were exposed in both private houses and working places. The results obtained suggested a clear influence of the soil type on indoor radon values: higher concentrations were obtained in dwellings built on the volcanic materials.

In this paper we present the results obtained in a larger survey that has been designed to improve the statistics and

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## VOLCANIC ZONE OF LA GARROTXA

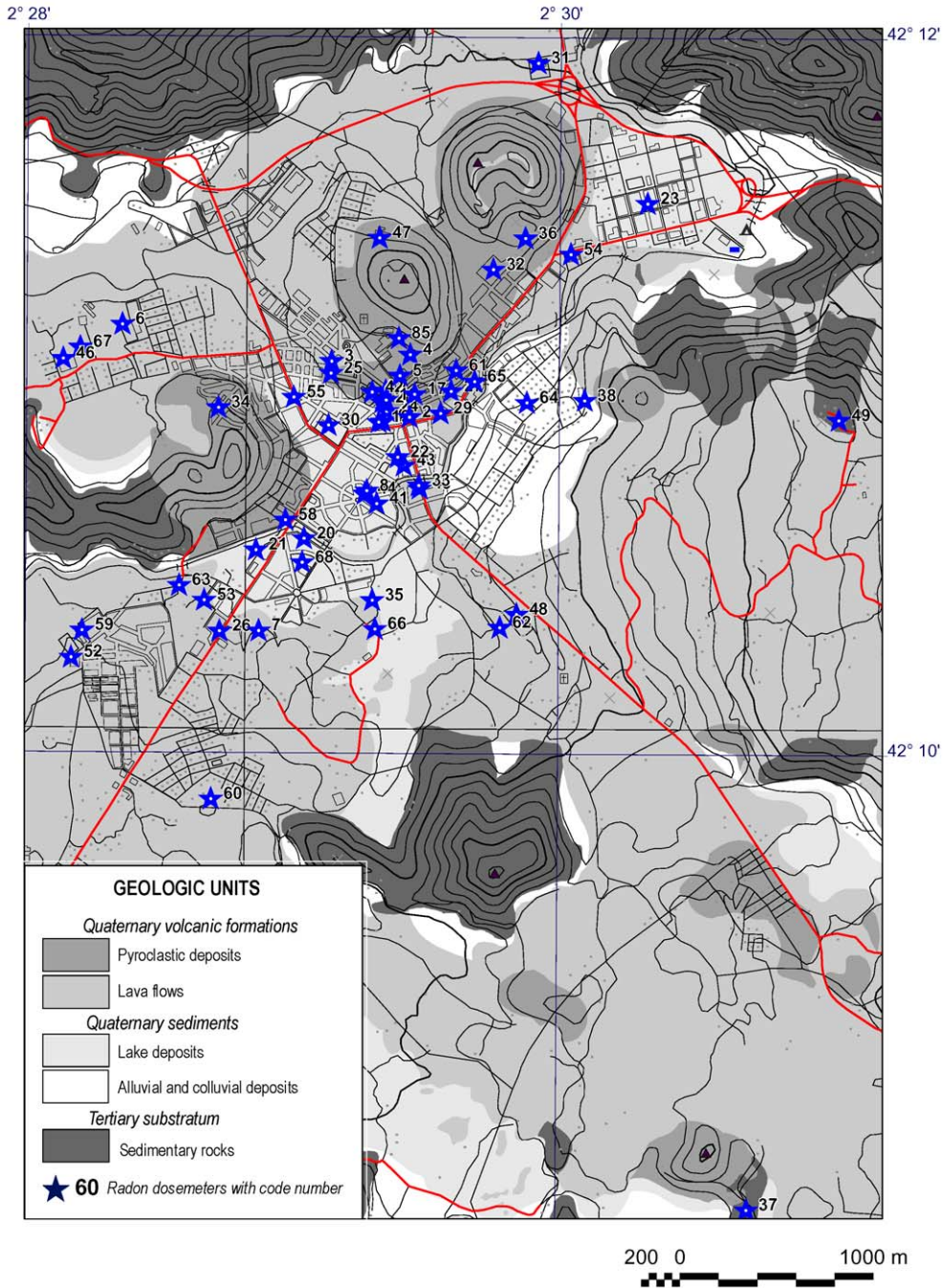


Fig. 1. Geological map of La Garrotxa volcanic region with the location of measurement points.

confirm the results of the preliminary survey. It means that the distribution of the dosimeters has been made considering two aspects: the interest on measuring radon levels in working places that might have high radon levels and the influence of volcanic formations on indoor radon levels.

## 2. Methodology

In the larger survey (April–July 2004) 56 dosimeters have been placed in rooms as close to the soil as possible (ground floor or basements), where radon levels are supposed to

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