



^{222}Rn concentrations, natural flow rate and the radiation exposure levels in the Nerja Cave

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Abstract

^{222}Rn concentrations in the air in Nerja Cave (Spain) have been measured over 4 yr and at four sampling points. Concentrations average 168 Bq m^{-3} in the spring–summer when the temperature lapse rate provides a stable cave atmosphere. In the autumn–winter, the radon levels decrease to 48 Bq m^{-3} . ^{222}Rn flux has also been measured for soils in the cave, with an average value of $34 \times 10^{-3} \text{ Bq m}^{-2} \text{ s}^{-1}$. The average natural flow rate in the spring–summer is about $0.70 \text{ m}^3 \text{ s}^{-1}$ and the autumn–winter is approximately $3.6 \text{ m}^3 \text{ s}^{-1}$ determined over 1992–1995. The radiation exposure levels for workers and tourists represent only a low percentage of the exposure guides for the general population. © 1998 Elsevier Science Ltd. All rights reserved.

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1. Introduction

The Nerja Cave was discovered in 1959. It is one of the most beautiful caves in Europe and is formed by water erosion of marble. Every year thousands of visitors enjoy wandering through the show cave with its impressive formations of stalactites and stalagmites. It is situated at about 4 km from the town of Nerja in the southern mountain range of Almjara, see Fig. 1; its entrance is at 158 m above sea level and less than 1 km from the coast line. The Nerja Cave lies in the heart of the dolomitic marbles of the Almjara Complex, part of the cluster of nappes in the Alpujarride Complex of the inner zones of the coastal mountain chain in Andalusia (the Betic mountain range). The Almjara mountain range is a lime-

stone massif which has few characteristic morphological features of karst. The marbles that form the nucleus of this mountain range are permeable materials and constitute an aquifer which is fed by the infiltration of rain water. The Nerja Cave has a variation in level of 70 m and its approximate volume is $278\,000 \text{ m}^3$, Carrasco and Durán (1994). The cave has three entrances, two of them are natural and one was constructed in 1960. It extends along a line N 35°E with a main axis about 250 m in length. It consists of a series of halls and side chambers separated by numerous banks of speleothems. Starting from the entrance we find successively the Vestibule Hall, the Ballet Hall, the Mirador Hall and the C. Hercules Hall, Fig. 2.

The ^{222}Rn levels encountered in a cave depend generally upon the net exhalation of radon from the rock surfaces and soil within the cave, the volume of the cave and the degree by which outside air mixes with cave air. The Nerja Cave is of particular interest in such a study

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