

Total natural radioactivity map of Veneto (Italy)

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INTRODUCTION

Following the IAEA recommendation for the development of radioelement baseline maps, here we present the total radioactivity map of the Veneto Region (Italy) (Fig.1) [1], based on γ -ray spectroscopy measurements. A map of the natural radioactivity content is a basic component for supporting research in physics, earth and life sciences. Many research projects focused on the absorbed dose distribution due to the natural background radiation or on mapping the geogenic radon according the distribution of the geological units. Although different research teams in the Veneto Region studied the indoor exposure to natural radioactivity and mapped the areas with elevated indoor radon levels [2], a map of the activity concentration is still a missing piece of knowledge in a region with one of the highest population densities in Europe.

METHOD

The Veneto Region (18264 km²) is classified into the Southern Alpine sector and Hill areas (SAH), covering approximately 39% of the territory, and into a wide River Plain area (RP) for the remaining 61% of the territory, constituted by quaternary alluvial deposits. The SAH areas were investigated following the Geological map [3] with the reconnaissance of lithostratigraphical units division at scale 1:250,000: a sampling strategy was planned to characterize the 41 Cartographic Units (CU) on the basis of the radiometric responses of representative rock samples. In the quaternary plain deposits of the RP, the distribution model of the activity concentration was obtained by geostatistical interpolation of the airborne γ -ray measurements, spatialized using the Ordinary Kriging interpolator. We realized the map of total natural radioactivity of the Veneto Region by using statistical arguments for combining all of the data into a unitary and coherent cartographic reference frame. In particular, the median value of the total activity concentration for each CU is assigned to the corresponding polygons in the SAH areas [4]. For each radionuclide (⁴⁰K, eU and eTh) in the RP areas, the omnidirectional Experimental Semi-Variograms (ESV) composed by 12 lags of 1 km were computed and modeled. The spatialization of the activity

concentrations of ⁴⁰K, eU and eTh were rasterized in a 200 m × 200 m grid and used to calculate the total activity concentration. The total activity concentrations were grouped into seven classes of percentiles, calculated on the total dataset of 19,735 records. In particular, the intervals of the classes were appropriately identified as the 5th, 20th, 50th, 80th, 95th and 100th percentiles.

RESULTS AND CONCLUSIONS

The 41 CU of the SAH areas were characterized with respect to the total activity concentration by means of 709 measurements on rock samples performed using a HPGe γ -ray spectrometer called MCA_Rad system [5]. Over 50% of the SAH areas primarily consists of limestones and dolomites, characterized by a low total activity, often resulting in Minimum Detectable Activity (MDA) values. The highest values of the total activity in the SAH areas are found in the magmatic rocks of the Euganean Hills and the Recoaro area, together with the crystalline basement.

The quaternary sediments of the RP area were investigated by airborne γ -ray spectrometry (AGRS) measurements [6], accounting for 75 h of effective time of flight, which correspond approximately 7000 km line. The extended area with medium-high values of total activity concentration could be related to anthropogenic activities [7] and selective fluvial depositions of the main river basins. In particular, we observed that the S-E area surrounding the Euganean Hills is characterized by enrichment in natural radionuclides, probably due to the erosion and transport processes undergone by magmatic rocks.

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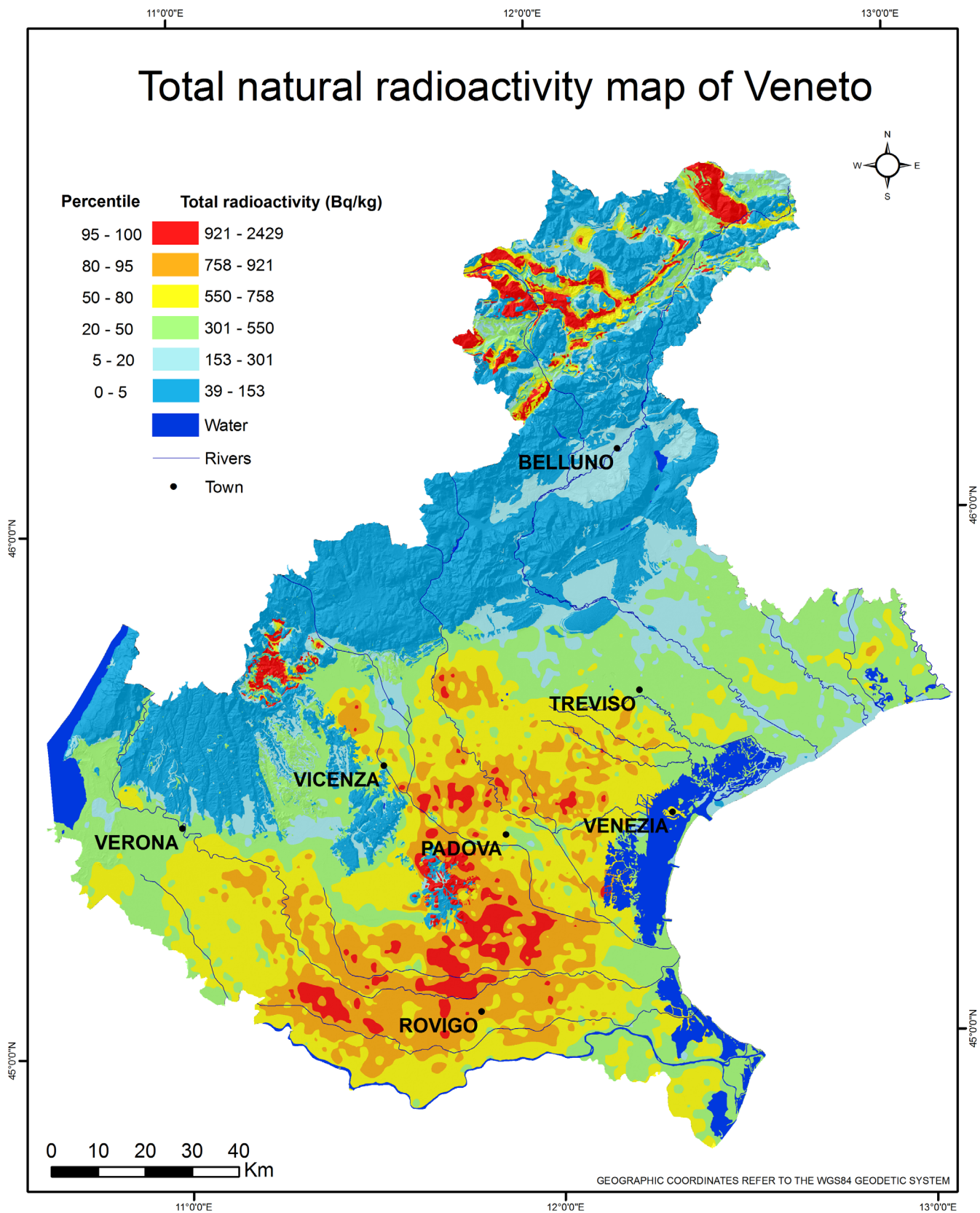


Fig.1 - The total natural radioactivity map of Veneto.