



Gamma-spectrometric measurement of radioactivity in agricultural soils of the Lombardia region, northern Italy



Laura Guidotti ^a, Franca Carini ^{a,*}, Riccardo Rossi ^b, Marina Gatti ^a, Roberto M. Cenci ^c, Gian Maria Beone ^a

^a Istituto di Chimica Agraria ed Ambientale, Facoltà di Scienze Agrarie, Alimentari e Ambientali, Università Cattolica del Sacro Cuore, Via Emilia Parmense 84, 29122 Piacenza, Italy

^b AEIFORIA Srl Spin-off of Università Cattolica del Sacro Cuore, Piacenza, Italy

^c BIO-BIO, Via Collina 13, 21023 Besozzo, Varese, Italy

ARTICLE INFO

Article history:

Received 4 October 2014

Received in revised form

7 January 2015

Accepted 8 January 2015

Available online

Keywords:

²³⁸U

²³²Th

¹³⁷Cs

Agricultural soil

Monitoring

LUCAS sampling

ABSTRACT

This work is part of a wider monitoring project of the agricultural soils in Lombardia, which aims to build a database of topsoil properties and the potentially toxic elements, organic pollutants and gamma emitting radionuclides that the topsoils contain. A total of 156 agricultural soils were sampled according to the LUCAS (Land Use/Cover Area frame statistical Survey) standard procedure. The aim was to provide a baseline to document the conditions present at the time of sampling. The results of the project concerning soil radioactivity are presented here. The aim was to assess the content of ²³⁸U, ²³²Th, ¹³⁷Cs and ⁴⁰K by measuring soil samples by gamma spectrometry.

²³⁸U, ²³²Th and ⁴⁰K activities range 24–231, 20–70, and 242–1434 Bq kg⁻¹ respectively. The geographic distribution of ²³⁸U reflects the geophysical framework of the Lombardia region: the soils with high content of uranium are distributed for the most part in the South Alpine belt, where the presence of magmatic rocks is widespread. These soils show an higher activity of ²³⁸U than of ²³²Th. The ²³⁸U activities become lower than ²³²Th when soils are located in the plain, originating from basic sedimentary rocks.

¹³⁷Cs activity ranges 0.4–86.8 kBq m⁻². The lowest activity of ¹³⁷Cs is in the plain, whereas the highest is in the North on soils kept as lawn or pasture. The ¹³⁷Cs activity of some samples suggests the presence of accumulation processes that lead to ¹³⁷Cs enriched soils.

This is the first survey of gamma emitting radionuclides in Lombardia that is based on the LUCAS standard sampling. The results from this monitoring campaign are important for the human radiation exposure and provide the zero point, which will be useful for assessing future effects due to external factors such as human activities.

© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

There is an increasing demand for soil data and information from policymakers to assess the state of soils at both the national and international levels. Agricultural soils are of special concern because they pose a direct threat to human and environmental health. To meet this demand, “Regione Lombardia” gave a mandate to the Università Cattolica del Sacro Cuore (UCSC) in Piacenza and

to the Joint Research Centre – Institute for Environment and Sustainability (JRC-IES) in Ispra in 2011 to assess the quality of agricultural soils in the Lombardia region through a three-year environmental monitoring program: the “Soil Mapping” project.

Agricultural topsoils in Lombardia have been sampled and analysed to determine their main properties and for potential toxic elements, organic pollutants and gamma-emitting radionuclides. These analyses were complemented by biological analyses in the second phase of the project. The survey represents the first effort in Lombardia to build a database of topsoil properties based on standard sampling and analytical procedures (JRC, 2013).

This work presents the part of the project that concerns the radioactivity of the soils. The main aim of this survey was to assess

* Corresponding author. Tel.: +39 3337553638.

E-mail addresses: franca.carini@unicatt.it (F. Carini), riccardo.rossi@aeiforia.eu (R. Rossi), roberto.cenci50@gmail.com (R.M. Cenci).

the content of the natural and anthropogenic radionuclides ^{238}U , ^{232}Th , ^{40}K and ^{137}Cs by measuring soil samples by gamma spectrometry. Monitoring of radioactivity in the environment is important for human and environmental protection and provides a baseline of environmental radioactivity levels.

Various surveys of anthropogenic and natural radionuclides in the soils of Lombardia have been carried out for determining radon risk, due to soil emissions and to building materials and to check for compliance with European and Italian rules in the years since the Chernobyl accident in 1986 (ARPA Lombardia, 2003, 2006; Cardinale et al., 1972; Busuoli et al., 1984; Sciocchetti et al., 1984; Campos Venuti et al., 1988; Facchini et al., 1992; Bochicchio et al., 1999). However systematic data on natural and anthropogenic radioactivity of soils in Lombardia are scarce. Baseline radioelement data are increasingly being used in decision making processes relating to land use, the environment, agriculture and public health. They are essential for policy makers and regulatory agencies, for the human radiation exposure and the formulation of sound environmental policies. This is the first survey on gamma emitting radionuclides in Lombardia, which is based on LUCAS (Land Use/Cover Area frame statistical Survey) standard sampling (EUROSTAT, 2000). The aim is of contributing to, and establishing a baseline map to document the conditions present in 2011 and to scientifically assess future effects due to external factors such as human activities.

2. Materials and methods

2.1. The survey location and its geological context

Lombardia region covers an area of 23 834 km² in North Italy (Fig. 1). It borders with Swiss to the North and extends southwards to the Po river, is limited by Lake Maggiore and Ticino river to the west and by Lake Garda and Mincio river to the east. It is characterized by a succession of different geological and structural areas which are from North to South: Alps, Southern Alps, Po Plain and northern Apennines. 40.5% of the territory is mountainous, mainly located in the northern area, 12.4% is hilly and 47.1% is flat located in the south. A minor mountainous area lies south of the Po in the Apennines range. The region is characterized by the presence of lakes of glacial origin and is crossed by several water courses, among which the Po river, which gives its name to the Po Plain.

Geological maps show that, in the Alps belt, metamorphic basements display almost everywhere an Hercynian overprint and evidences of volcanic activity. Along the Periadriatic Lineament it is possible to recognize polyphase metamorphic complexes, widely intruded by plutonic bodies whose chemical composition shows a temporal progression from peraluminous to calcalkaline and finally high-K calc-alkaline character (APAT, 2004). Magmatic rocks, belonging to high-K calc-alkaline, to shoshonitic and ultrapotassic series present anomalous high values of U. The areas where these



Fig. 1. Geographical position of the Lombardia region in Europe.

Download English Version:

<https://daneshyari.com/en/article/8082313>

Download Persian Version:

<https://daneshyari.com/article/8082313>

[Daneshyari.com](https://daneshyari.com)