

THE EXPERIENCE OF EMILIA-ROMAGNA REGION AND ARPAE

HEAVY METAL MAPPING TO SUPPORT THE MANAGEMENT OF SOIL AND STONES

One of the features of heavy metals is that they are always present in the soil in variable quantities depending on the sediments that gave origin to them, on their texture and soil-forming processes that over time altered chemical characteristics, increasing or lowering the content of some elements (natural background content); at the same time, they result from several human activities and show a tendency to accumulate in the most superficial layer of the soil through the atmospheric fall out or the widespread supply of solids or liquids that is mainly linked to agronomic practices. As a result, the natural content plus the enrichment resulting from anthropic activities (natural-anthropic background content) will be found in the most superficial layer. Despite the availability of extensive literature, identifying any natural geochemical anomalies and defining the widespread contamination effects in the soil is a rather complex and controversial issue.

Since 2005, the Geological, Seismic and Soil Service of the Emilia-Romagna Region started a knowledge process within the collaboration with the University of Bologna, Arpaie and the National Research Centre of Florence, drafting the following maps in line with ISO/DIS 19258:2005 standard: "Soil quality - Guidance on the determination of background values":

1) chrome, copper, nickel, lead, vanadium and zinc natural background map in a 1:250,000 scale representing the local distribution of metal concentration at a depth of about one metre (90-130 cm): the map representation is based on polygons and the basic information layers are the map of soils and that of reservoirs

2) arsenic, chrome, copper, nickel, lead, tin, vanadium and zinc natural-anthropic background map in a 1:250,000 scale representing the local distribution of metal concentration in the most superficial 30 cm, which can be regarded as representative of the topsoil in farming land. The map is based on geostatistics using finite square elements with 1 km long sides and proxies that include agronomic management.

Both maps are available on the following web sites of the Geological Services: <http://bit.ly/suoli-ER> and <http://bit.ly/cartografia-suoli-ER> under the item "Suoli" and can be downloaded from the Regional Geocatalogue.

Maps can be consulted on-line, sending queries to the polygon/EQF for which 50th, 90th, 95th percentile values in mg/kg are provided. In this way, users receive additional information as well as the natural or natural-anthropic background value corresponding to 95th percentile (figure 1).

The maps produced by the soil division of the Geological Service aim at helping technical officers in charge of evaluating the soil parameters laid down in the different environmental procedures, introducing them in the regional/local context as per 2006 Ispra (former Apat) guidelines for the determination of the background value. In practical terms, geological, soil and geochemical information are available in just one on-line map that provides either the natural or anthropic background value of the area at issue whenever a query is sent.

The Italian legislation regulates the metal concentration in the soil in mainly three cases: Legislative Decree 99/92 on the use of waste sludge from urban water treatment in agriculture, Legislative Decree 152/2006 (Part IV Title V) for the reclamation of contaminated sites, the Ministerial Decree 161/2012 or Art. 41bis of Law 98/2013 on the re-use of soil and stones.

Excavated ground and rocks can be managed as by-products by way of derogation from the waste regime in compliance with Law 98 Art. 41 bis or Ministerial Decree 161/2012.

The management of soil and stones under a simplified regime (Art. 41) establishes that the applicant or producer shall certify that the contamination threshold concentration values as per columns A and B of table 1 of annex 5 to part IV of the Legislative Decree 152/2006, with reference to the characteristics of the environmental matrices and to the urban use of the place of destination are not exceeded and that the

materials are not a source of direct or indirect contamination for underground waters, except for the natural background values. The Ministerial Decree 161/2012 provides that materials intended for reuse have to comply with threshold concentration of contamination (col. A or B with reference to the specific use) "except if the applicant can demonstrate, by relying on past analyses and studies that have been already assessed by the relevant bodies, that the values have been exceeded due to the soil natural characteristics or to natural phenomena and that, as a result, the measured concentrations refer to the natural background values" (Ministerial Decree 161/2012, annex 4).

If the materials are used in a place that is different from the production one, this should happen in an area with a natural background having similar and comparable characteristics for all parameters being exceeded.

In 2014 a collaboration was started between Arpaie and the Geological, Seismic and Soil Service for using background content maps. Arpaie is in charge of a number of functions: it carries out surveillance and control activities and runs a specific database that allows to catalogue and geo-reference the site-specific data relating to the places of production and destination of soil and stones that are handled at regional level. A comparative analysis of the physical-chemical characteristics of the handled material declared by the producer, with respect to the analytical screening provided by the maps developed by the Regional Geological Service provide guidance for carrying out *in situ* document control and inspection on the received files.

The main problem when applying the current legislation is relating the sample concentration value ranging from 0 to 1 m to the natural background value, because this range of depth refers to both the natural and anthropic content for soils.

Therefore, the screening data were firstly compared with the map of the anthropic natural content, defining an experimental procedure suitable to evaluate the cases in which the applicant/producer declares that the contamination threshold values taken as background values have been exceeded. In 2017 the comparison will be carried out using the map of the natural background content too.

As a whole, the experimental procedure allowed to use maps "on site", further validating them and, at the same time, it will ensure that more reliable analytical data are selected for the new 2017 edition, with the purpose of achieving different goals: an optimum management of environmental data, database integration and the collaboration between bodies having different competences.

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FIG. 1 - SOIL MAPPING
Example of Gis map output.