

Geochemical characterization, isotopic constraints and environmental risk assessment in the Domizio Flegreo and Agro Aversano area (Campania region)

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1. Introduction

We have completed a comprehensive geochemical environmental study focused on topsoil, groundwater, vegetable (corn) and human hair samples. This is a detailed effort that follows former that pointed out the occurrence of heavy metal pollution throughout this area. Lead isotopic analysis of different materials have been carried out to discriminate among the possible contamination sources of Pb and to establish their geogenic and/or anthropogenic nature.

2. Study area

The Domizio Flegreo Littoral and Agro Aversano area (Fig.1) covers 1287 km² and includes 90 municipalities.

This study concentrated on specific sites that may have been affected by different sources of pollution (from industrial to agricultural, and urban): Teverola Fondo Comunale), Trentola-Ducenta (Fondo Bove), Giugliano (Fondo Zaccaria), Castelvolturno (Soglitelle- Laghetti). Moreover, many industries are also present such as a production branch of FIAT, and the Montefibre plant, which produces polyester fibers. Within the administrative boundaries of the municipality of Acerra, there is a large urban waste treatment incinerator that has the capacity of 750,000 tons operating since 2009.

3. Sampling

1064 topsoil, 27 groundwater, 24 human scalp hair and 13 corn samples have been collected across the study area.

Soil samples (with an average weight of weight 2.5 Kg) have been collected based on a sampling grid with cells of 1 km² (Fig. 3- 5)

Groundwater samples have been collected in HDPE bottle for metals, anions and cation analysis from existing wells. (Fig. 4- 6)

Human scalp hair samples (with an average weight of ~ 50 g) have been collected in some barber shops collaborating with our research group.

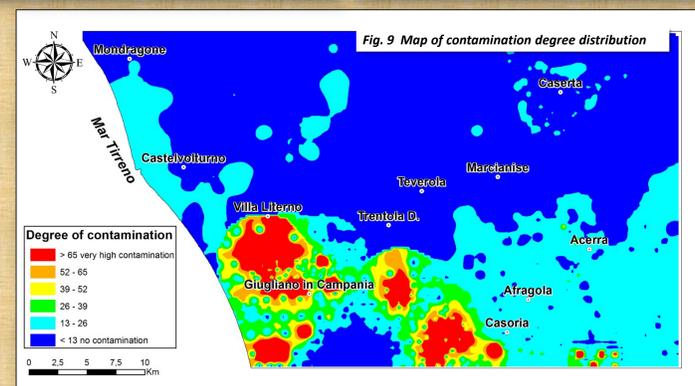
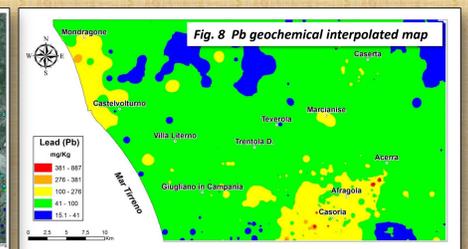
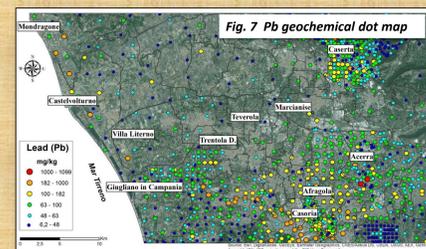
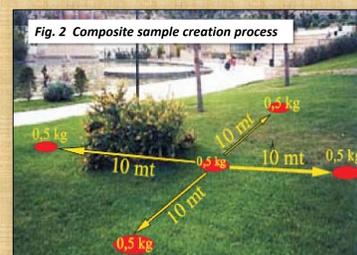
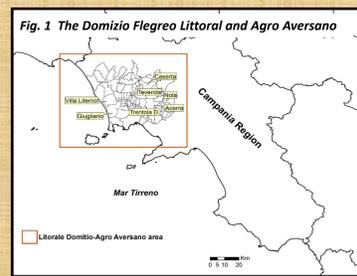
Corn samples have been collected from storage silos located in some local agricultural cooperatives of the area.

4. Analysis and geochemical mapping

For all samples the concentration of 53 elements have been determined at ACME Analytical Laboratories (Vancouver, Canada).

Samples have been analysed by inductively coupled-plasma-mass spectrometry (ICP-MS) and atomic emission spectrometry (ICP-ES), after an *Aqua Regia* digestion.

Attention has been especially paid to 15 potentially toxic elements (As, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V and Zn) for which the Italian Environmental Law 152/06 establishes trigger and action limits both for residential/recreational and for industrial/commercial land uses. All the data have been statistically treated and dot and interpolated maps have been produced by means of the GeoDAS software. Fig (7- 8- 9)



5. Isotopic data

Pb isotopic analyses have been carried out at the Radiogenic Isotope Laboratory of U.S. Geological Survey (Reston, VA, USA), using HR-ICP-MS [Thermo Scientific Element2].

The Pb isotope data allowed us to discriminate geogenic vs. anthropogenic sources for Pb in soil that Pb isotopic compositions of human hair generally match the Pb isotopic ratios defined by aerosol and gasoline. (Fig. 11) This overall coincidence is consistent with the interpretation that the source of the Pb is due to anthropogenic activities in the area.

