

# Bioaccumulation of heavy elements by *Armadillidium vulgare* (Crustacea, Isopoda) exposed to fallout of a municipal solid waste landfill



Francesco Nannoni <sup>a,\*</sup>, Roberto Mazzeo <sup>b</sup>, Giuseppe Protano <sup>b</sup>, Riccardo Santolini <sup>b</sup>

<sup>a</sup> Department of Physical, Earth and Environment Sciences, University of Siena, Siena, Via del Laterano 8, Siena I-53100, Italy

<sup>b</sup> Department of Earth, Life and Environmental Sciences, University of Urbino "Carlo Bo", Urbino I-61029, Italy

## ARTICLE INFO

### Article history:

Received 17 February 2014

Received in revised form 22 September 2014

Accepted 23 September 2014

### Keywords:

Terrestrial isopods

Soils

Environmental quality

Tissue absorption

Bioindicators

Gut emptying

## ABSTRACT

This paper reports the response of isopods exposed to fallout of a municipal solid waste landfill located in central Italy. Soil samples and specimens of *Armadillidium vulgare* were collected at different distances from the landfill and analyzed to determine the concentrations of heavy elements such as As, Cd, Co, Cr, Cu, Ni, Pb, Sb, V and Zn. The isopod analysis was performed on unpurged and purged specimens. Analytical data indicate that the soil contents of heavy elements were quite uniform and within the respective local geochemical background. Slight enrichments of Cu and Pb were found in some soils collected within the solid waste. Purged isopods showed an accumulation of As, Co, Cr, Ni, Sb and V whose body levels decreased as the distance from the landfill increased. Cd, Cu, Pb and Zn concentrations in purged specimens were rather uniform and no significant variation trend occurred. This result probably was due to the fact that the isopods are provided with physiological mechanisms of regulation for these heavy elements. Analytical data also indicate the ability of *A. vulgare* to adsorb differently the heavy elements according to the following order: As > Co > Ni > Pb > V. The contents of heavy elements in unpurged specimens were higher than in purged ones. This finding suggested that the defecation has marked effects on the tissue levels of heavy elements in isopods. This study indicates that the isopods provide useful information about environmental quality in areas characterized by low and discontinuous emission of heavy elements and their low accumulation in soil.

© 2014 Published by Elsevier Ltd.

## 1. Introduction

Landfilling is currently the most widely used method for disposal of municipal solid waste mainly in highly populated areas (Giusti, 2009; Loukidou and Zouboulis, 2001). The waste landfill sites are often the causes of concern due to their adverse effects on the environment and human health. The environmental impact of municipal solid waste landfilling is mainly due to groundwater, soil and air contamination as well as vegetation damage (El-Fadel et al., 1997).

The solid waste landfills may cause soil contamination by heavy elements via dispersion of particulate matter by wind (so-called fallout) and leachate release (Bogner and Matthews, 2003; Bretzel and Calderisi, 2011; El-Fadel et al., 1997; Iwegbue et al., 2010;

Koshy et al., 2009; Rizo et al., 2012; Waheed et al., 2010; Yarlagadda et al., 1995). The airborne particles are produced by re-suspension from the disposed waste and other operations of waste management such as mechanical recycling and composting, burning of residues, unloading and sorting of waste (Fitz and Bumiller, 2000). Particulate matter reflects the chemical composition of disposed waste which often includes heavy element-rich household hazardous substances such as batteries, paints and inks (Erses and Onay, 2003; Koshy et al., 2009).

Leachate is produced principally by interaction between decomposing solid waste and precipitation percolating through landfill. The leachate migration can cause the contamination of groundwater and soil by heavy elements (Hong et al., 2002).

The environmental impact of the practice of municipal waste disposal in landfills is usually evaluated through the chemical analysis of inorganic and organic substances in air, groundwater and soil. Although the ecotoxicological aspects are relevant and biomonitoring should be mostly used as a valuable tool to assess

\* Corresponding author. Tel.: +39 0577 233950; fax: +39 0577 233945.  
E-mail address: [nannoni@unisi.it](mailto:nannoni@unisi.it) (F. Nannoni).

the influence of waste landfilling, very few researches used bioindicators in order to assess the environmental quality in waste landfill sites (Cabrerá and Rodríguez, 1999; Gagnon and Saulnier, 2003; Sang and Li, 2004), and no study investigated the heavy element uptake and accumulation in soil organisms such as isopods.

In contaminated ecosystem, detritivorous organisms such as terrestrial isopods may be exposed to high heavy element levels, because both their food source (organic matter) and their microhabitat in upper layer of soil profile where these elements usually are accumulated (Martin et al., 1982). Uptake and accumulation of heavy elements by isopods has been intensively studied (e.g., Dallinger and Prosi, 1988; Hopkin and Martin, 1982; Witzel, 1998). Moreover, it is known that these crustaceans are suitable bioindicators for studies of environmental contamination by heavy elements, due to their ability in immobilizing these chemicals within body (Odendaal and Reinecke, 2004a; Paoletti and Hassall, 1999; Vijver et al., 2006; Witzel, 1998). For these reasons, terrestrial isopods represent one of the taxa most suitable to provide reliable information on environmental quality.

The present study aims to determine the accumulation of heavy elements such as metals (Cd, Co, Cr, Cu, Ni, Pb, Sb, V, Zn) and metalloids (As) by the isopod *Armadillidium vulgare* (Latreille, 1804) exposed to the fallout of the municipal solid waste landfill of Monte Schiantello (central Italy). The main purposes of the study are: (i) to assess the influence of the waste landfill inputs on distribution of heavy elements in soil; (ii) to define the

relationships between the accumulation of heavy elements in isopods and the distance from the landfill; (iii) to evaluate the real tissue absorption of heavy elements by isopods.

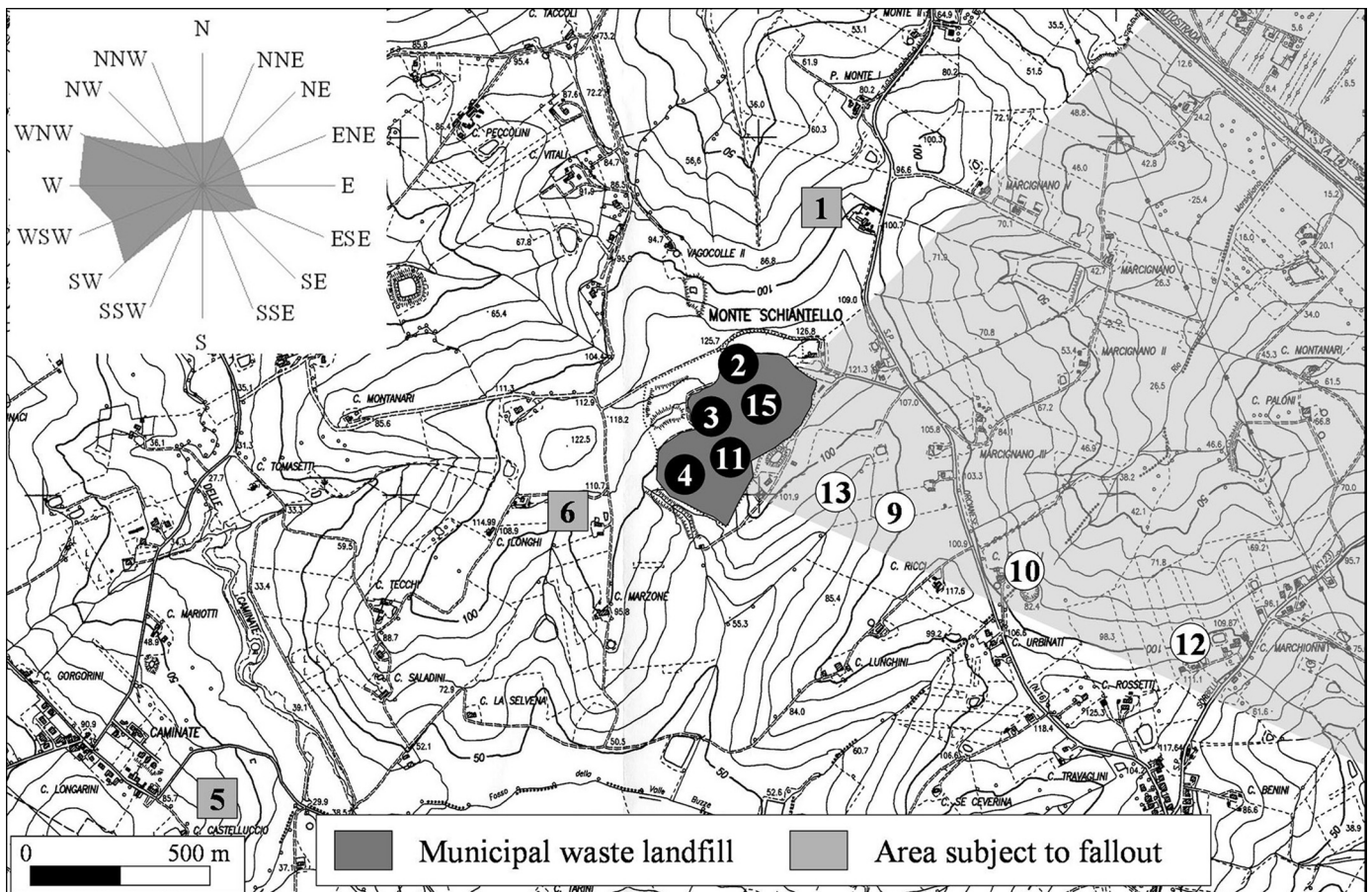
## 2. Materials and methods

### 2.1. Study area

The study area is located in the southern sector of the municipality of Fano (PU, central Italy), about 6 km S-SW from the urban center, and includes the municipal solid waste landfill of Monte Schiantello.

The landscape is hilly with elevation usually between 50 and 130 m above sea level. The area is predominantly agricultural and the presence of vegetation is relatively low. From the geological point of view, the Argille azzurre formation crops out in the study area. This lithostratigraphic unit (Plio-Pleistocene) consists of clayey-silty-marine sediments. The data from the meteorological station, located in the Monte Schiantello landfill, indicated that the prevalent directions of wind are from WNW, W and SW (Fig. 1).

The municipal solid waste landfill of Monte Schiantello is divided into two batches: the first batch was utilized from 1978 to 1995 and at present it is covered by soil; the second one has been in use since 1995. The landfill covers a surface of about 25 acres and it is classified as a “landfill for municipal and not hazardous waste” according to the Italian Legislation (Italian Legislative Decree no. 36/2003). The amount of disposed wastes was



**Fig. 1.** Main directions of wind and location of sampling sites in the area of the municipal solid waste landfill of Monte Schiantello. (■) Control sites, (●) landfill sites and (○) fallout sites. Background sites placed about 3000 m from landfill (BG-7, BG-8 and BG-14) are not reported in the figure.

Download English Version:

<https://daneshyari.com/en/article/6294774>

Download Persian Version:

<https://daneshyari.com/article/6294774>

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