



## Polycyclic aromatic hydrocarbons in the sediments of the Gulfs of Naples and Salerno, Southern Italy: Status, sources and ecological risk

Chengkai Qu<sup>a,b</sup>, Jiji Li<sup>c,\*</sup>, Stefano Albanese<sup>b</sup>, Annamaria Lima<sup>b</sup>, Menghan Wang<sup>b,d</sup>, Marco Sacchi<sup>e</sup>, Flavia Molisso<sup>e</sup>, Benedetto De Vivo<sup>f</sup>

<sup>a</sup> Shaanxi Key Laboratory of Earth Surface System and Environmental Carrying Capacity, College of Urban and Environmental Sciences, Northwest University, Xi'an 710127, China

<sup>b</sup> Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli "Federico II", Naples 80134, Italy

<sup>c</sup> National Engineering Research Center for Marine Aquaculture, Marine Science and Technology College, Zhejiang Ocean University, Zhoushan 316022, China

<sup>d</sup> Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Optoelectronic Engineering, Shenzhen University, Shenzhen 518060, China

<sup>e</sup> C.N.R. Istituto Geomare Sud, Napoli, Italy

<sup>f</sup> Pegaso University & Benecon Scarl, Dipartimento Ambiente e Territorio, Naples 80138, Italy

### ARTICLE INFO

#### Keywords:

Polycyclic aromatic hydrocarbons  
Sediment  
Gulf of Naples and Salerno  
Bagnoli brownfield site

### ABSTRACT

This study investigated the spatial distribution, potential sources, and toxic effects of polycyclic aromatic hydrocarbons (PAHs) in the sediments of the Gulfs of Naples and Salerno (NaSa Gulfs), Southern Italy. The investigation focused on the coastal sea sediments of the Bagnoli brownfield site within the Gulf of Naples. The  $\Sigma_{16}$ PAHs in the sediments of the NaSa Gulfs outside of the Bagnoli brownfield site have concentrations that ranged from 9.58 to 15,818  $\mu\text{g}/\text{kg}$ , with a geometric mean (Gmean) of 234  $\mu\text{g}/\text{kg}$ . High-molecular weight PAHs (HMW PAHs) contributed to over 80% of the  $\Sigma_{16}$ PAHs. The concentration of  $\Sigma_{16}$ PAHs in the Gulf of Naples was twice as high as that in Salerno (768  $\mu\text{g}/\text{kg}$  and 317  $\mu\text{g}/\text{kg}$ , respectively), and the  $\Sigma_{16}$ PAHs levels in the Bagnoli brownfield site exceeded that in the NaSa Gulfs by over three orders of magnitude. The molecular distributions of PAHs studies suggested biomass/coal combustion as their main sources. Based on the analysis of the toxic equivalent quantity and sediment quality guideline quotient, the contamination of PAHs in sediments may pose significant toxicity and biological risks to marine organisms.

### 1. Introduction

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants whose presence in coastal marine sediments have received considerable attention (Arienzo et al., 2017; Dudhagara et al., 2016; Peng et al., 2015). Marine sediments are among the important reservoirs of PAHs, and may receive these contaminants from three input sources, namely, pyrogenic, petrogenic, and diagenetic origins (Montuori and Triassi, 2012). Once introduced into the marine environment, PAHs do not easily biodegrade, and can accumulate in the fatty tissues of cells rather than the aqueous compartments inside organisms (Kronenberg et al., 2017; Yim et al., 2005). The potential toxicity of PAHs to aquatic organisms may threaten marine biodiversity and human health through bioaccumulation in the food chain (Viguri et al., 2002). Given their potential toxic effects, 16 PAHs have been confirmed as priority pollutants by the United States Environmental Protection Agency (US EPA), 7 of which, are classified as carcinogenic

PAHs by the International Agency for Research on Cancer (Yu et al., 2015).

The Campania region has one of the highest population densities in Italy, with over half of the population concentrated in the Naples metropolitan area. At present, illegal waste dumping, industrialization and farming practices in the Campania region present harsh challenges in mitigating the increasing levels of contamination (Qu et al., 2016, 2017). The Gulfs of Naples and Salerno (NaSa) are the receiving environment for persistent toxic substances from the Campania Plain (Albanese et al., 2010; Arienzo et al., 2017; Romano et al., 2004). Montuori and Triassi (2012) reported that the discharges of PAHs from the Sarno River to the Gulf of Naples is approximately 8530 g/d. The lack of knowledge surrounding sediment pollution scenarios caused by PAHs hinders the comprehensive understanding of their environmental fate and deleterious effects. A handful of studies have reported the levels of PAH contamination in a selected areas of the Naples Gulf, such as Pozzuoli Gulf (Arienzo et al., 2017), Port of Bagnoli (Romano et al.,

\* Corresponding author.

E-mail address: [lijiji@zjou.edu.cn](mailto:lijiji@zjou.edu.cn) (J. Li).

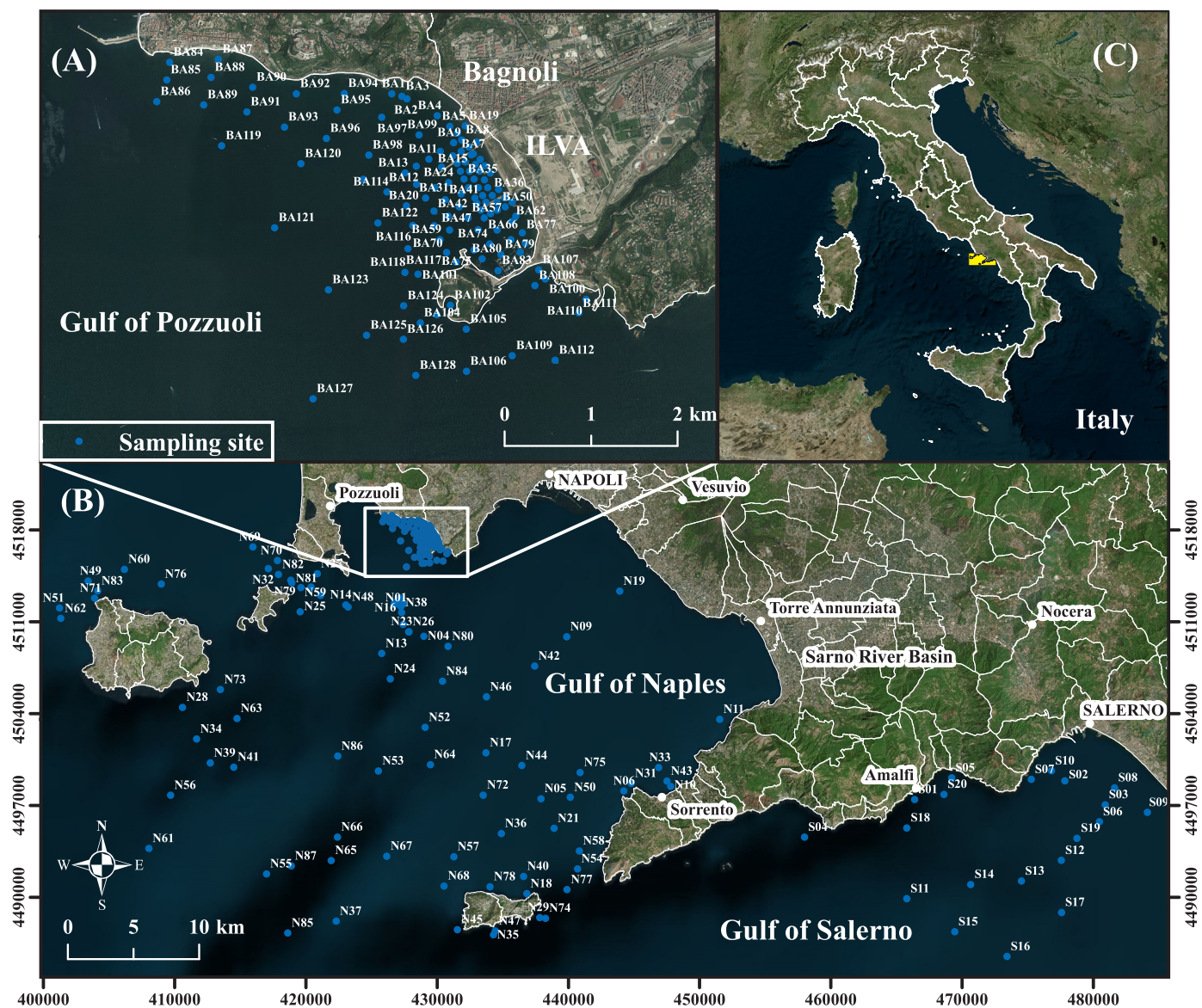


Fig. 1. Map showing the sediment sampling site locations in the NaSa Gulfs.

2004), and Naples harbor (Sprovieri et al., 2007). However, a regional-scale study of sediment contamination is urgently needed.

The current paper reports the spatial variations in the concentrations of PAHs in the sediments of the NaSa Gulfs, Southern Italy. The specific objectives of the present study are to: (I) investigate the contamination levels and spatial distribution of PAHs, (II) identify their potential sources and (III) evaluate the toxicity of the sediment PAHs.

## 2. Methods

### 2.1. Study area

The Gulfs of NaSa are located along the Eastern Tyrrhenian Sea, separated by the Sorrento Peninsula. The Gulf of Naples is semi-enclosed by the Ischia-Procida Islands to NW, Campi Flegrei and the Campanian Plain in NE, and the Sorrento peninsula in SE. The Gulf of Salerno is located along the coastal area, offshore of the Sele Plain (Fig. 1). Within the Gulf of Naples, the rates of sediment accretion in Pozzuoli are estimated to be approximately 2.55 mm/y (Passaro et al., 2013). The industrial pollution, high population density, busy port, concentrated railway-highway-road networks, and a large influx of

visitors to the Naples metropolitan area and province of Salerno, result in high environmental stressors in the Gulfs of NaSa (Albanese et al., 2010; Qu et al., 2016).

In the last century, Bagnoli Bay within the Gulf of Naples has been occupied by several major industrial factories, such as ILVA (steel), Eternit (asbestos materials), Cementir (cement), and Federconsorzi (agricultural chemicals). Most of these factories were dismantled between 1990 and 2000, and the resulting brownfield site has undergone a large-scale remediation programme funded by the Italian government (De Vivo and Lima, 2018). The pollution present in the area mainly originates from organic pollutants, particularly PAHs and PCBs, which are found in the soils and underground waters of the brownfield sites, and along the shoreline. An important concentration of PAHs and PCBs occurs within a structure, known as the ‘Colmata’, which is delimited by two piers and filled with scum, slag and landfill materials from the steel factory (ILVA) (Albanese et al., 2010).

The term “*Terra dei Fuochi*” (Land of Fires) indicates a territory, located between the cities of Naples and Caserta in the Campania region. The territory is characterized by the illegal burning of urban waste, as well as, grasslands, and forests. From 2000–2012, a total of 44,071 fire events were recorded in the area, covering an area of

Download English Version:

<https://daneshyari.com/en/article/8853677>

Download Persian Version:

<https://daneshyari.com/article/8853677>

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