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SCIENCE DIRECT

Environment International 31 (2005) 1040 – 1046

ENVIRONMENT INTERNATIONAL

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Temporal trends in the sources of PCDD/Fs to and around the Venice Lagoon

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Abstract

Two salt marsh cores were collected from the Venice Lagoon, Italy, and analysed for PCDD/Fs. The samples were undisturbed and had an approximately constant accumulation rate. Radiochemical chronologies were established for the different core sections. The PCDD/F pattern in the surficial layers was very similar to that of atmospheric deposition measured in the same area. However, the pattern changed with increasing depth and was very different in the deeper sections, where the highest PCDD/F concentrations were measured. This layer was dated around the 1950s. Deeper layers have a profile similar to the surficial one. Undisturbed salt marsh cores appear to be a reliable tool for the reconstruction of temporal trends in the atmospheric deposition of persistent organic pollutants. It is proposed that the trends in the core reflect atmospheric deposition that probably results from the sum of two different contributions: emissions of the industrial district of Porto Marghera on the edge of the lagoon and the regional background.

Keywords: Salt marsh; Trends; PCDD/F; Atmospheric deposition; Venice Lagoon

1. Introduction

The Venice Lagoon, situated along the north-western Italian coast, has a long history of pollutant emissions from industrial settlements, primarily located on the edge of the lagoon, in Porto Marghera (Fig. 1). The first industrial settlement started its activity after the First World War and expanded considerably after 1933. Industrial production and, as a consequence, emissions to the environment are thought to have peaked during the 1950s/1960s. Major industrial activities include the production of a wide range of chemicals (including vinyl chloride) and oil refining. Other contributions to persistent organic pollutant (POP) emissions were the historical centre of Venice, placed in the middle of the lagoon, an MWI incinerator, urban settlements, and agricultural activities located in the drainage basin. In addition, until the end of the 1970s, most of the industrial effluents were discharged into the lagoon without treatment, along with other local deliberate discharges. During the last two decades, the adoption of new abatement technologies and the decline of the industrial district have led to a consistent reduction in inputs to the lagoon ecosystem (Marcomini et al., 1999). It is believed that the contemporary dominant contributions are atmospheric deposition and riverine input, both recently monitored by field investigations (Zuliani et al., this issue; Collavini et al., this issue), while direct discharges from the industrial district are nowadays probably less relevant (Marcomini et al., 1999). The riverine input, together with the direct discharges to the lagoon, originates mainly from industrial and agricultural activities, and their influence and temporal trends on the lagoon system can be studied by looking at dated sediment cores from the industrial canals or from the central lagoon. The atmospheric deposition input, however, reflects the contribution of various human sources over a wider regional background. Salt marsh cores have been used in the past to reconstruct historical trends of pollutants (Bellucci et al., 1999; Gaus et al., 2001) because when the

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0160-4120/$ - see front matter © 2005 Published by Elsevier Ltd.
doi:10.1016/j.envint.2005.05.014

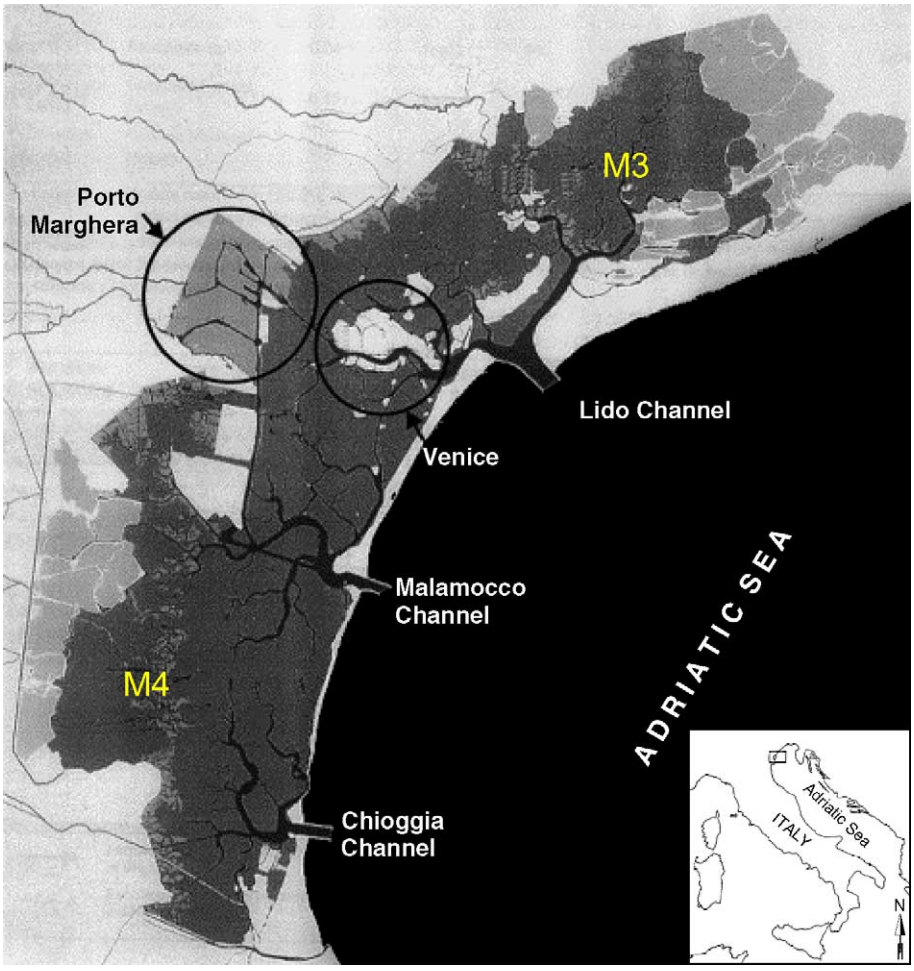

Fig. 1. Map of the Venice Lagoon.

right conditions occur, accumulation of pollutants is a direct reflection of atmospheric deposition. In this study, data were obtained from the analysis of two cores collected in salt marsh areas of the Venice Lagoon dated at different depths (Frignani et al., in this issue).

Hence, the objectives of this work were to assess the extent of the influence of the industrial district over the Venice Lagoon, and to assess the suitability of salt marsh cores to study the temporal evolution of the atmospheric loading of POPs to the area. In order to achieve the first objective, a brief description of PCDD/F distribution over the lagoon sediment is given, together with an account of the atmospheric deposition data available for the lagoon area. The suitability of the salt marsh cores as a tool to reconstruct historical trends of POPs in the lagoon will be discussed, by comparing the dated profiles with the contemporary atmospheric deposition.

2. Materials and methods

Atmospheric deposition input fluxes to the lagoon were estimated through a sampling campaign lasting for over a year between 1998 and 1999. Samples were collected monthly with bulk samplers at four sampling stations. Two of them were placed in the central lagoon area (one in the historical centre of Venice and one in the industrial district of Porto Marghera) and the other two in relatively remote areas, on the edge of the southern and northern lagoon. A summary of the results has been reported by Dalla Valle et al. (2003), while details are reported in Rossini et al. (2001) and Guerzoni et al. (2004).

Sediment samples from the salt marshes were collected manually using a Plexiglas corer, immediately extruded, and frozen until analysis (for a detailed account of the procedure, see Frignani et al., in this issue). Sediment accumulation rates were established through the interpretation of activity depth profiles of ^{210}Pb and ^{137}Cs as reported by Sorgente et al. (1999), and for the same cores by Frignani et al. (in this issue). The reliability of the sediment chronology is high due to the absence of mixing and bioturbation of the sediment cores. The chronology is even more reliable in recent times due to the ^{137}Cs spike caused by the Chernobyl accident. The accumulation rates appear to have varied little over time and are estimated to be between 0.33 and 0.43 cm/year for the two cores. A detailed