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First results on the study of metal contamination along the Corsican coastline using *Posidonia oceanica*

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Abstract

This study aims at determining the metal concentrations in blades and sheaths of *Posidonia oceanica* adult leaves, in 16 stations of the Corsican coastline. It shows that except for Cr, all the metals are preferentially accumulated in the blades. This result is particularly interesting as it means that trace metals analyses may be carried out only on the blades avoiding thus the removal of the shoots. Moreover, this study shows that metal concentrations generally fall within the range of the lowest values available in literature and may reflect the "background noise" of the Mediterranean. Station 15 (Canari) can however be distinguished from the others due to its high Co, Cr and Ni concentrations. This result may be related to the presence of a previous asbestos mine, located near this station. Therefore, this study reinforces the relevance of the use of *P. oceanica* as a tracer of metal contamination.

Keywords: Trace metals; Corsica; *Posidonia oceanica*; Asbestos mine; Mediterranean

Résumé

Cette étude vise à la détermination des concentrations métalliques dans les limbes et les bases des feuilles adultes de *Posidonia oceanica*, au niveau de 16 stations du littoral de la Corse. Elle montre qu'à l'exception de Cr, tous les métaux sont préférentiellement accumulés dans les limbes. Ce résultat est particulièrement intéressant puisqu'il implique que les analyses de métaux traces peuvent être effectuées uniquement sur les limbes, permettant ainsi d'éviter de prélever la totalité du faisceau. De plus, cette étude montre que les concentrations métalliques sont globalement parmi les valeurs les plus faibles de la littérature et refléteraient le bruit de fond de la Méditerranée. La station 15 (Canari) peut cependant être distinguée des autres stations par ses fortes concentrations en Co, Cr et Ni. Ce résultat peut être mis en relation avec la présence d'une ancienne mine d'amiante située à proximité de cette station. Par conséquent, cette étude renforce l'intérêt de l'utilisation de *P. oceanica* en tant que traceur de la contamination métallique.

Mots-clés: Métaux traces; Corse; *Posidonia oceanica*; Mine d'amiante; Méditerranée

1. Introduction

Trace metals are regarded as serious pollutants of the aquatic environment because of their toxicity, their persistence, their difficult biodegradability and their tendency to concentrate in aquatic organisms (Ikem and Egiebor, 2005).

There is currently a great interest in the use of living organisms as pollution biomonitors in aquatic ecosystems (Goldberg, 1986; Andersen et al., 1996; Pergent-Martini and Pergent, 2000; Usero et al., 2005; Demirezen and Aksoy, 2006) and, in the Mediterranean sea, the endemic seagrass *Posidonia oceanica* (L.) Delile has been used as a metal bioindicator for several decades (Maserti et al.,

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1988; Sanchiz et al., 1990; Costantini et al., 1991; Catsiki and Panayotidis, 1993; Malea et al., 1994; Warnau et al., 1995, 1996; Pergent-Martini, 1998; Schlacher-Hoenlinger and Schlacher, 1998; Capiomont et al., 2000; Campanella et al., 2001).

The Corsican island is usually considered as a pristine region having healthy and widespread *P. oceanica* meadows (Pasqualini et al., 1998). However, most studies are relative to a single punctual station (Warnau et al., 1995, 1996) and/or are focused only on mercury accumulation (Maserti et al., 1988; Pergent-Martini, 1998; Capiomont et al., 2000; Claisse et al., 2001; Ferrat et al., 2003).

Thus, the aim of this study is to evaluate the metal contamination of the Corsican coastline thanks to the species *P. oceanica*.

2. Materials and methods

Shoots of *P. oceanica* were collected during the summer 2003, at 10 ± 1 m depth and in 16 stations located along the Corsican coastline (France; Fig. 1). Only blades and sheaths of adult leaves were analysed (Giraud, 1979). Samples were rinsed (ultrapure water), frozen (−20 °C), lyophilized (>72 h in Heto® FD4-85 freeze dryer, HetoHolten A/S) and then manually reduced to a powder.

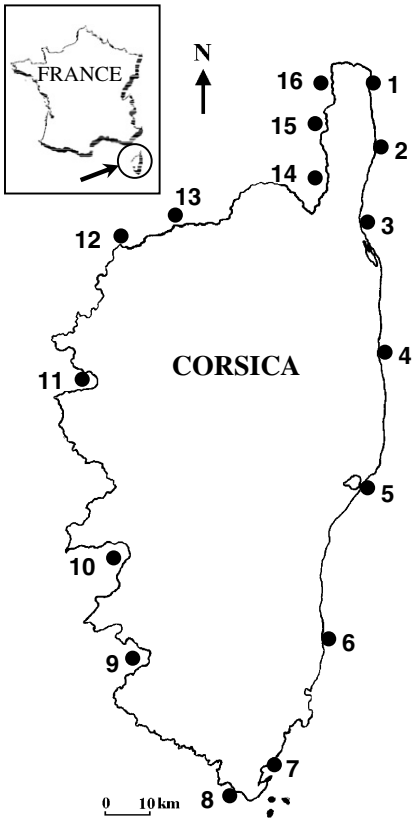

Fig. 1. Study area and sampling stations. 1: Macinaggio; 2: Sisco; 3: Bastia; 4: Campoloro; 5: Diane; 6: Solenzara; 7: Sant'Amanza; 8: Bonifacio; 9: Propriano; 10: Ajaccio; 11: Porto; 12: Calvi; 13: Lumio; 14: Saint Florent; 15: Canari; 16: Centuri.

Concerning mercury (Hg), samples were mineralized and then analysed with a cold vapour atomic absorption spectrometer (Perkin Elmer®). The analyses of the other metals (cadmium: Cd; chromium: Cr; cobalt: Co; lead: Pb; nickel: Ni) were run with quality assurance procedures at the Laboratory of Rouen/ETSA (Rouen, France) and were realized using a graphite furnace atomic absorption spectrometer. The analytic procedure was verified using certified reference material (*Lagarosiphon major*, CRM 60; Community Bureau of Reference – Commission of the European Communities).

Significant differences between tissues and between stations were determined by a two-way analysis of variance (ANOVA). Correlations between metals were performed by analysis of Pearson's correlations. For these statistical analyses, the values below the detection limit have been considered as half the value of the detection limit.

3. Results

The concentrations of Cd, Co, Hg, Ni and Pb are significantly higher in blades than in sheaths ($P < 0.05$) whereas Cr is more accumulated in sheaths ($P < 0.05$; Fig. 2).

The concentrations of most of the metals vary considerably with the sampling stations. The Cd concentrations in stations 2, 10, 11, 12, 14, 15 are significantly higher than in stations 3, 4, 5, 7, 8, 9 ($P < 0.05$; Fig. 3). The highest Co, Cr and Ni concentrations are recorded in stations 14 and 15. The Co concentration in station 15 and the Cr and Ni concentrations in stations 14 and 15 are significantly higher than in all the other stations ($P < 0.05$; Fig. 3). The lowest Hg concentration is recorded in station 12 ($P < 0.05$), while the Hg concentration in the other stations reach levels similar to each other (Fig. 3). The Pb concentration in station 10 records the highest value; it is significantly higher than in stations 1, 4, 7, 8, 9, 13 and 15 ($P < 0.05$; Fig. 3).

4. Discussion and conclusion

This study shows that, except for Cr, the trace metals are preferentially accumulated in blades. This has been previously reported by Warnau et al. (1996) and Campanella et al. (2001) for Cd; Maserti et al. (1988), Sanchiz et al. (1990) and Capiomont et al. (2000) for Hg; Sanchiz et al. (1990) and Campanella et al. (2001) for Pb. This result is particularly interesting as it suggests that, except for Cr, analyses of metal concentrations may be realized only on blades allowing thus to collect the samples (the blades) without removing the entire *P. oceanica* shoot.

At the scale of the Mediterranean sea, the contamination levels reported in this study generally fall in the range of the lowest values available in literature. Indeed, all of our values are much lower than those found for the impacted site of Antikyra Gulf in Greece (Malea et al.,