CONCENTRATION OF MERCURY IN MARINE PHANEROGAM *POSIDONIA OCEANICA*. PRELIMINARY RESULTS

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The accumulation of trace metal in the tissues of marine phanerogams has been the object of numerous studies. It seems that mercury concentration measured in the leaves of *Posidonia oceanica* is representative of levels present in sea water (AUGIER *et al.*, 1978). The base of the leaves of *Posidonia oceanica* (sheath) presents the particularity of remaining attached along the rhizome, after the fall of the limb, and of remaining within the matte for several decades. Furthermore, thanks to the variations in thickness of the sheath (a cycle limited by two minima of thickness corresponds to one year), it is possible to date their period of formation very precisely with a technique which can be assimilated to dendrochronology : lepidochronology (PERGENT, 1990). These remains of sheath, which can inform us on the conditions prevailing at the time of their formation (temperature, turbidity, sedimentation rate,..) can also memorize levels of radioelements present in the environment (e.g. Caesium 137 in CALMET *et al.*, 1991).

For the purpose of the present study, 48 orthotropous rhizomes were collected in January 1993 from one site of the bay of Calvi (Corsica) by scuba-diving at -10 m depth. They were separated into three equal parts dissected according to the lepidochronological method. *Posidonia oceanica* leaves were separated according to their type (adult or intermediate). The old sheaths, present on each rhizome were very carefully detached, respecting the distichous insertion order (rank), and numbered from the more recent (near the living leaves) to the older (near the base). Sections of rhizomes, delimited by two minima thickness (corresponding to one annual cycle), were equally selected. Mineralization of the samples was realised with a mixture of acids (sulfonitric) and oxygenated water, in Nalgene FEP Teflon bottles put in the microwave. Dosage of mercury was performed with the help of a flameless atomic absorption spectro-meter (MAS 50B, Perkin Elmer). If, for a given structure (blades, old sheaths or rhizomes), mean mercury concentration levels vary according to its age, one notes that registered levels in the rhizomes are higher than those registered in other structures (Figure 1). This preferential accumulation of mercury in the rhizomes is already mentioned in the literature on sites of weak environmental contamination (MASERTI *et al.*, 1988). The date of sampling (season) could however also play an essential role in the accumulation of mercury in the leaf tissues of *P. oceanica*, as this has already been observed with other phanerogams (WARD, 1987). Our results show that mercury concentrations do not occur at random in the sheaths of *P. oceanica*. Concentrations are strongly correlated to the weight of sheaths ($y = 0.29 - 0.55\,x$, $r = 0.74$). By erasing this correlation it is possible to assess the difference between theoretical concentration (only due to the weight) and observed concentration (Figure 2). It then appears that this difference reflects seasonal patterns of accumulation. They provide evidence of the occurrence of cycles of mercury concentration, according to sheath insertion rank. These cycles are synchronized with the sheath thickness variation cycles.

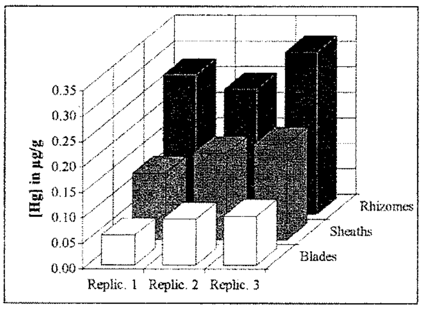

Figure 1 : Mercury levels in the different tissues of *Posidonia oceanica* collected in January 1993.

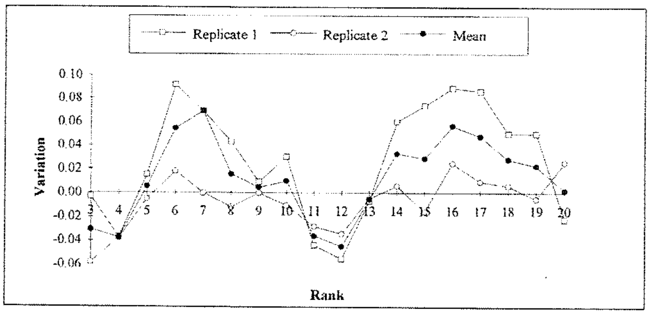

Figure 2 : Variation (in µg/g) between theoretical and observed mercury concentration, in *Posidonia oceanica* sheaths, on the basis of the insertion rank.

In the future, we plan to investigate whether the accumulation of trace metal by *Posidonia oceanica* shows significant variations according to the season. We shall therefore analyse trace metal concentrations in the various leaf tissues of *Posidonia oceanica* over an annual cycle.

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THE SEA OF MARMARA AS A POLLUTING ROUTE

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The Sea of Marmara, an enclosed basin which permits exchanges of distinct different waters from the Black and Aegean seas through the two narrow and shallow straits of Bosphorus and Dardanelles, acts as a receiving water environment not only for industrial and domestic waste discharges but also for chemical pollutants from the adjacent seas. Accordingly, excess amount of organic matter and nutrients entering the Marmara surface waters both from the Black Sea through Bosphorus surface flow and from land-based sources, which have drastically modified the marine ecosystem, reach as far as the Mediterranean Sea through the Dardanelles Strait.

The annual rates of chemical exchanges between the Marmara Sea and the two adjacent seas including the entrainment fluxes are illustrated in Fig. 1, together with recent estimates of water fluxes and annual means of chemical properties of the exchanging waters. Systematic data of inorganic and particulate nutrients and organic carbon were obtained during the national oceanographic studies in the Marmara Sea whereas the dissolved organic nitrogen and dissolved ammonia data were derived from the literature as discussed recently in POLAT and TUGRUL (1994). It appears that the entrainment free loads of total phosphorus (TP), total nitrogen (TN) and total organic carbon (TOC) entering the Aegean Sea from the Marmara Sea through the Dardanelles are about 1.0×10^4, 1.3×10^5 and 1.8×10^6 tonnes per year respectively. Such loads are very similar to the inputs from the Black Sea into the Marmara surface layer, but at least 3-4 times larger than the exports from the Aegean Sea through the Dardanelles. As also clearly seen from the mean concentration data displayed in the figure, the saline waters of Mediterranean origin in the lower layer of the Marmara basin, which are poor in nutrients before entering the basin, are enriched with such chemicals by nearly ten-fold relative to its initial value at the Dardanelles Strait due to the input from the productive surface layer of the Marmara Sea. The decay of organic matter sinking from the surface waters have resulted in an oxygen deficiency in the lower layer of the Marmara Sea though the Aegean inflow into the basin is saturated with dissolved oxygen.

When the Marmara inputs to the Aegean Sea through the Dardanelles (see Fig.1) are compared with the riverine, atmospheric and Atlantic loads (COSTE *et al.*, 1988, BETHOUX *et al.*, 1992, MONTÉGUT, 1993), it can be suggested that they contribute to the nutrient pools of the Mediterranean Sea at the comparative levels with the anthropogenic inputs, but being about an order of magnitude less than the Atlantic input as expected.

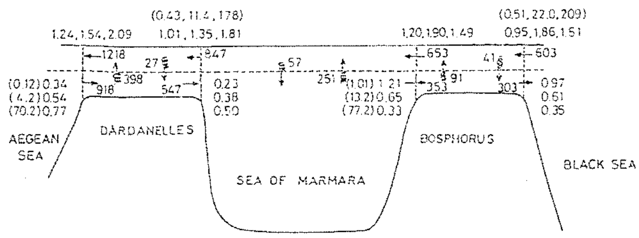

Fig. 1. The annual fluxes of water (values given with the arrows, km^3y^{-1}, BESIKTEPE, 1991), TP, TN and TOC through the Marmara Sea and the straits. The numbers are in the order of phosphorus ($x10^4$ tons P), nitrogen ($x10^5$ tons N) and organic carbon ($x10^6$ tons C). The values in parantheses are the annual average concentrations (µM) of TP, TN and TOC.

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