CHARACTERIZATION, IMPACT AND FATE OF ATMOSPHERIC INPUTS IN THE WATER COLUMN

SANDRONI, V., C. MIGON
Laboratoire de Physique et Chimie Marines,
Université Paris 6, CNRS-INSU,
Quai de la Darse, BP 8, 06238
Villefranche-sur-mer,
France

The transport of matter by the atmospheric pathway is responsible for an efficient spreading of many compounds to the sea [1]. Owing to its relatively reduced dimensions (surface area : 8.4 10^5 km^2), as well as numerous and intense land-based emission sources along its shores, the western Mediterranean basin is particularly subjected to particulate and dissolved atmospheric inputs, whether they are of anthropogenic origin or natural pulsed inputs such as Saharan dust events [2,3].

Total atmospheric fluxes in the northwestern Mediterranean Sea have been already described for several compounds among which trace metals [2,4]. Some marine flux data restricted to continental shelf waters or nearshore coastal waters exist in the Mediterranean Sea (see review in [5]). However, long-term observations on marine fluxes are still lacking in open Mediterranean waters. Consequently, data dealing with concomitant atmospheric and marine fluxes are also lacking. The coupling of an atmospheric sampling site with a marine sampling site should improve the knowledge of transfer processes of atmospheric inputs to the deep water layer, and also bring more indications on the potential fertilization of the surface waters by atmospheric inputs.

Processes of downward transfer in the water column are presumably governed by biological activity [6,7], itself depending on hydrological (seasonal stratification of waters) and meteorological conditions (wind events, sunniness). The description and quantification of the different (dissolved + particulate) atmospheric loadings is the preliminary step for assessing the fate of atmospheric matter in the water column (in the present work, sediment trap data at 200 and 1000 m depths are not available yet). Trace metals constitute good indicators of process studies for the biogeochemical response of the marine environment to external constraints [8].

The present results, obtained from continuous sampling (wet, dry and total inputs) at the Cap Ferrat sampling station (Ligurian Sea) enable to quantify the dissolved and particulate fractions relative to various types of metals (dust-derived, anthropogenic, medium). Figure 1 illustrates three typical behaviours, always linked to the emission sources.

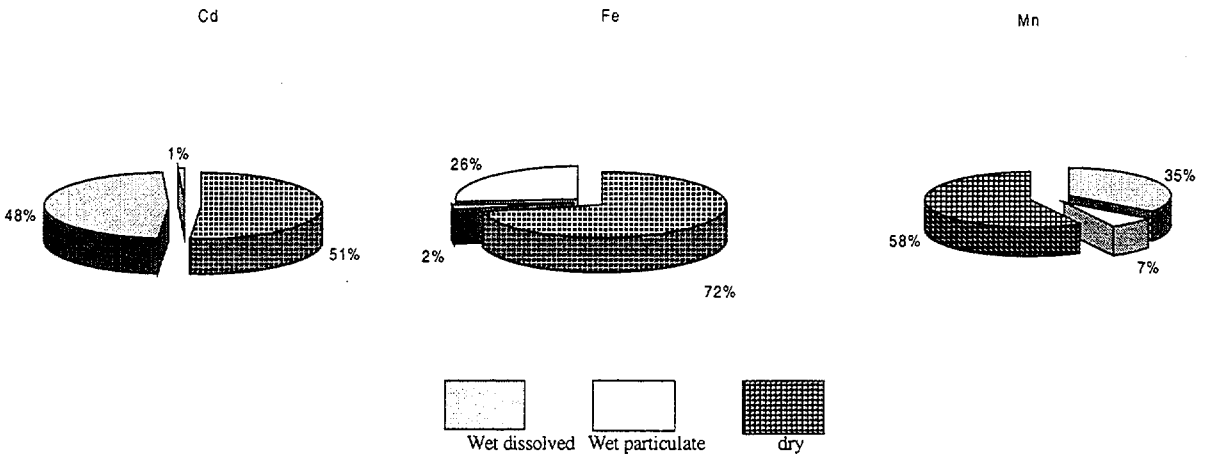

FIG. 1. Disolved and particulate fractions realative to various types of metals.

Coupled with concomitant sediment trap data, these results should bring worthy informations on exchange and transfer processes that occur in the water column (e.g., exchanges between dissolved material and suspended particles, mineralization, transfer of metals by biogenic or lithogenic particles). The potential fertilizing role of the atmosphere is also assessed, with the case of P, which probably regulates phytoplankton dynamics in the Mediterranean Sea [9, 10]. Phosphate concentration was measured in rainwaters from February 1997 to February 1998 at the Cap Ferrat sampling site. Soluble (reactive + complexed) and particulate P were distinguished. Total P concentrations exhibit a high temporal variability (0.05 to 4.3 μmol l^{-1}). Figure 2 shows the various P fluxes : for a total of 165 μmol m^{-2} y^{-1}, the dissolved and particulate inputs represent 95 and 70 μmol m^{-2} y^{-1} respectively. Anthropogenic emissions might be responsible for most of soluble (bioavailable) P.

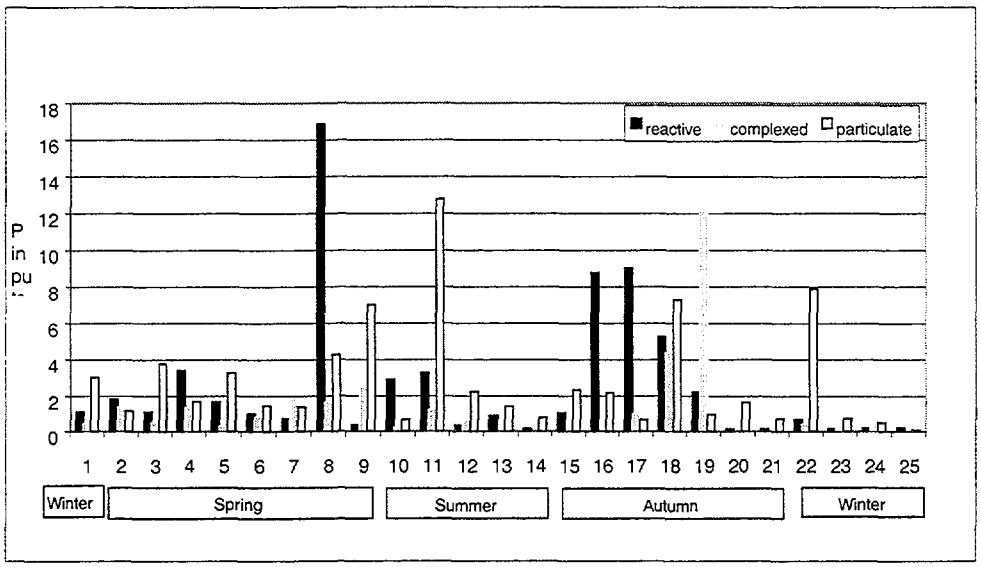

FIG. 2. Phosphate fluxes.

At a global scale, the atmosphere is a minor source of P (if compared with telluric inputs and marine vertical mixing). However, in oligotrophic conditions, it might be the only source of P to surface waters. For example, the rain event of June 19th 1997 (17 μmol reactive P m^{-2}) potentially induces a new production of 0.2 g C m^{-2}. This is a minimum value, which does not take into account the partial assimilation of complexed or particulate P.

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