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Trace metal (Hg, Pb, Cd, Cu, Ni, Mn, Fe, Co) distribution in Eastern-Atlantic surface waters. Reflection of natural and anthropogenic sources by comparing data from 1990 and 2005

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On “POLARSTERN” cruise ANT XXIII/1 seawater surface samples were taken by high frequency between the Bay of Biscay and Cape Town in the eastern Atlantic to study two main objectives:

1. Mercury distribution under consideration of the main oceanic regimes, and meteorological systems, including an oceanic region which is affected by high Saharan dust deposition.

2. Distribution of trace elements like Cd, Pb, Cu, Ni, Co, Mn, Fe, and the comparison to a dataset from 1990 and the reflection to natural or / and anthropogenic sources.

Total mercury (Hgtot) concentrations were directly analysed on board of “POLARSTERN” by using cold vapour technique with mercury amalgamation on a gold net and the determination by fluorescence detection. From 23˚N to 0˚ Hgtot concentrations are well correlated to the distribution of manganese in the surface water. They are ranging between 2.0 and 4.5 pmol/L on a higher level, which is due to Sahara dust input by North-East trade winds. Southward and northward of these area concentrations decrease to very low levels of 0.5 - 3.0 pmol/L.

The concentrations of Cd, Pb, Cu, Ni, Co, Mn, Fe were analysed, after liquid-liquid extraction by graphite furnace atomic absorption.

Dissolved lead (Pb) concentrations are ranging between 5-20 pmol/kg in 2005 with slightly increasing values in the Intertropical Convergence Zone (ITCZ). In 1989 concentrations were by factor 2 higher in this region, while maximum values (factor 10-15 higher) were obtained in the North Atlantic which was related to anthropogenic atmospheric Pb input by the prevailing westerly wind directions from the industrialised areas of northern America. After 15 years most of the Pb was removed from surface waters by scavenging.

The comparison of iron (Fe) and manganese (Mn) data show nearly identical concentrations between 1990 and 2005. While Mn shows a strong maximum between 23˚N-0˚, the Fe maximum is shifted to 7˚N. Since both elements are mainly of natural terrigenic origin these results are possibly due to the composition of atmospheric transported dust from different sources. Also residence times and seasonal effects in the water column have to be taken into account.

Distribution of nickel and copper concentrations are nearly identical between the two transects in 1990 and 2005 with slightly increasing values in the northern hemisphere. These elements were not influenced by Saharan dust input.

It seems, that also for cadmium and cobalt atmospheric input from the African desserts can be neglected. For both elements it looks like, that different seasonal up-welling regimes (Equatorial up-welling, Guinea Dome, Angola Dome) are responsible for the fluctuation of surface concentrations.