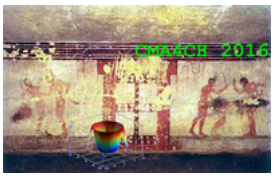
CMA4CH 2016, Mediterraneum Meeting
Straightforward approach in Cultural Heritage and Environment studies - Multivariate Analysis and Chemometry
6th ed., Rome, Italy, Europe, 18-20 December 2016



Organic (Halocarbons) and Inorganic (Elements) Characterization of Soil and Rivers in the North Latium Region

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Abstract

This paper shows a characterization of the organic and inorganic fraction of river waters (Tiber and Marta) and ores/soil samples collected in the Northern Latium region for evaluating the anthropogenic/natural source contribution to the environmental pollution of that area. For the qualitative and quantitative assessment of the inorganic fraction it is highlighted the use of an analytical nuclear method, Instrumental Neutron Activation Analysis, which allows to have more information as possible from the sample without performing any chemical-physical pre-treatment. The results have evidenced high levels of mercury, antimony, strontium and zinc whereas Rare Element Earths show levels similar to the literature data. For organic compounds, organochloride volatile compounds in Tiber and Marta rivers were analysed by two different clean-up methods (i.e. liquid-liquid extraction and static headspace) followed by GC-ECD analysis. The results show very high concentrations of bromoform, due to the presence of greenhouse crops, and chloroform and tetrachloroethene, due to the presence of handicrafts installations.

Introduction

Pollution episodes can be caused both by natural sources and humans. If it is easy to understand such phenomena due to anthropogenic activities, it is not trivial to recognize and evaluate events due to natural occurrences. Among the large amount of species present in the environment a particular attention should be devoted to both organohalogen compounds in the organic fraction and heavy metals in the inorganic fraction.

Many halocarbons become air pollutants, water pollutants in surface and groundwater resources and as soil contaminants. Heavy metal is a general collective term, which applies to the group of metals and metalloids with an atomic density greater than 4 g cm^{-3}.

In this paper, we have evaluated the inorganic fraction in terms of elements, and the organic compounds such as halocarbons, in a large area located in the Northern Latium (North of Rome). Intensive sampling campaigns of ores and river-water, Tiber and Marta, were performed for evidencing the anthropogenic/natural impact of different activities in that area. From the analytical point of view, for the qualitative and quantitative evaluation of inorganic elements a highly specific nuclear method was used, the Instrumental Neutron Activation Analysis (INAA), which allows to have much information as possible from the sample without having to stress from the point of view of analytical preparation [1].

Materials & Methods

Sampling site - Soil and river water samples were sampled in the Northern Latium. The water samples were taken in spring-, summer- and fall-time as well as more than 100 ores were collected from 8 different areas in the same region.

Organic fraction - Chloroform, trichloroethane, hexachloroethane, tetrachloromethane, chlorobenzene, trichloroethene, dichlorobromomethane, bromoform, tetrachloroethene, dibromochloromethane, tetrachloroethane were extracted by liquid-liquid extraction (LL) and

headspace analysis (HS) and analysed by means of GC-ECD.

Inorganic fraction - The neutron irradiation was performed in the TRIGA Mark II nuclear reactor at the R.C. Casaccia-ENEA, the γ spectrometry measurements were performed by means of an HPGe detector. According to the half-life of each element, more than 40 elements were determined

Results

Organic fraction - The analytical parameters used for the evaluation of the organic compounds were evaluated in terms of linearity range, LODs, repeatability and recoveries. The values by HS and LL extraction are quite similar confirming the reliability of the two analytical methods. The compound concentration does not vary during the sampling period. High concentrations of bromoform, chloroform and tetrachloroethene constitute an interesting result: bromoform levels are probably due to the presence of agricultural crops in greenhouse whereas chloroform and tetrachloroethene to the presence of handicrafts installations. Sampling of drinking water performed in different points of Rome's water supply was also carried out for assessing the effect of anthropogenic activities on the water quality. The results show any significant pollution problems for samples collected at Peschiera-Cittaducale and Peschiera-Castelluccia springs whereas for other springs significant traces of some organohalogens were found even if the sum is below the law limit.

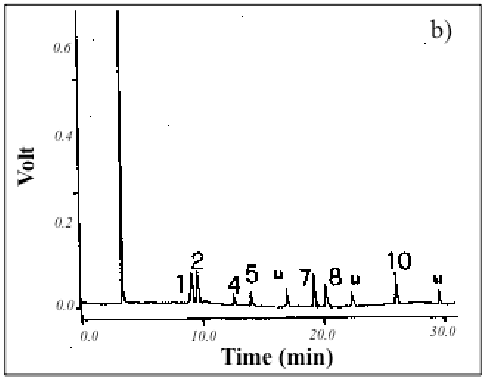

Fig. 1; Gas chromatogram of a Tiber river water sample. Peaks: 1 $CHCl_3$; 2 CCl_3CCl_3; 4 CCl_2CHCl; 5 $CHBrCl_2$; 7 $CHCl_2CH_2Cl$; 8 $CHClBr_2$; 10 $CHBr_3$; u unknown

Inorganic fraction - A large number (40) of elements have been determined: this performance allows investigating deeply the characteristics of such province in order to classify it. Among the elements, some results seem very interesting: high mean levels of Hg, As, Sb, Sr, Zn whereas the Rare Earth Elements (REEs) show mean levels quite similar to literature data of crustal average composition [2].

The mean arsenic levels are very high in all the areas in relationship to the very low levels of arsenic in the earth crust (5 $\mu g\ g^{-1}$): the average value varies between 90 $\mu g\ g^{-1}$ and 1150 $\mu g\ g^{-1}$. This occurrence is really important: in fact, one of the most important problems in the Northern Latium region (and particularly in Viterbo area) is the presence of arsenates in spring waters and potable ones as well.

Conclusions

The paper reports the characterization of an area in the Northern Latium (Italy) in terms of organic and inorganic species. From the organic point of view, the results show that, independently of the investigated seasons, the analyte concentrations do not vary significantly in both rivers. Further, it should be pointed out that in the Marta River there is a strong concentration of bromoform and chloroform, while in the Tiber River high concentrations of chloroform, trichloroethene and tetrachloroethene are present: in both cases the anthropogenic sources are the main responsible. On the other hand, for the inorganic fraction the INAA analysis has evidenced high mean levels of Hg, As, Sb, Sr, Zn whereas Rare Element Earths show mean levels similar to literature data. Among elements it should be noted the case of As: the levels found in this paper explains the high content of such element in the aquifer. Such occurrence causes presence of arsenates in spring waters and in relative water network. Finally, a statistical approach has allowed evidencing the almost common origin of the soils studied.

References

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2) B. Mason, C.B. Moore, Principles of Geochemistry. 4th ed. John Wiley, New York, 19982.