

Atmospheric Elemental Dispersion

Maria do Carmo Freitas

The research in this field is focused on studies of atmospheric environment, nutrition and health. The investigation appeared as a natural application of the potentialities of k_0 -INAA (instrumental neutron activation analysis using the k_0 -method). Through the re-equipment project with FCT and a technical cooperation with IAEA, new facilities were installed aiming at the automatization, the optimization and introduction of new variants of NAA. Compton suppression and prompt gamma facilities, as well as automatic sampler changers and renewal of the detection systems in the fast pneumatic system, are goals which were initiated. As applications, taking advantage of the available equipments, the main lines are:

Monitoring, Biomonitoring, Quality Control, and Data Handling aiming at characterising areas of Portugal using lichen transplants, air particulate matter collection, and (wet+dry) deposition. The data are analysed for factors aiming at identifying emission sources and the spread of elements through the atmosphere, both locally and by long-range transport. Data analysis methods and their development are very important due to the multielement nature of the analytical technique used. To assure the quality of the data, accuracy and precision studies are being performed, both in biomonitoring and monitoring fields, aiming at better understanding differences found in the results for the same element and sample. Air particulate matter obtained by different air samplers is compared. So-called conventional analytical techniques are applied to complement the research unit's results. Within this activity line, the following are being done: services to industry (monitoring), FCT funded project research (both biomonitoring and aerosol monitoring) and training (three current PhD theses on biomonitoring). Collaborations with Universities are also on-going,

namely with Azores University, Aveiro University, IST/Lisbon Technical University, and Évora University.

Epidemiological studies include health related problems. The objective is to link biomonitoring and monitoring to epidemiological studies, at local, regional and European scale. Currently, one PhD is dedicated to this subject.

Element Uptake Processes. The group also enters the plant physiology looking for effects on plants due to atmospheric chemical components. The underlying questions are related to the extent in which lichens may reflect the element contents of particulate matter, which may possibly be dominated by its soluble element concentration fractions. This is the subject of one PhD thesis.

Nutrition. The group is increasing the investigation in nutrition studies through a PhD thesis aiming at a better knowledge of selenium in the Portuguese diets. Selenium is a nutrient, which should be included in the human organism within a very narrow mass a mount range, otherwise severe diseases should be expected. Also nutrition contents in spices and rice originated from Sri Lanka are still being studied, following a IAEA fellowship. Honey analysis is being surveyed for Azores islands and Portugal mainland, a more complete study is now taken in Algarve region.

Training. The research unit has a strong component in post graduation training.

Services. Analytical services are also provided under request (private companies, public services). It is hoped that the new variants and automatization initiated in 2006 and to be finalized in 2007, will bring an increasing number of analytical services.

Research Team

Researchers

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Development, Automatization and Optimization in Activation Analysis

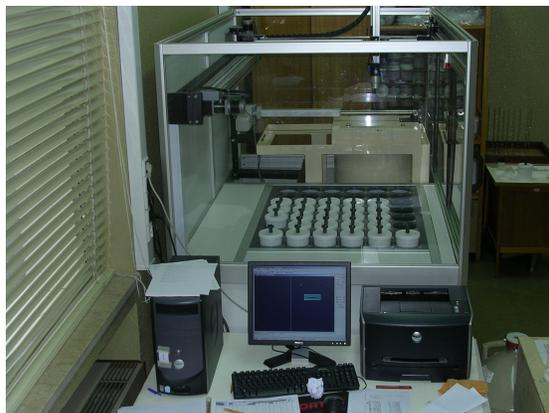
M.C. Freitas, I. Khan, D.G. Beasley

Objectives

Within re-equipment project (REEQ/1075/FIS/2001), a Technical Cooperation with IAEA (POR/6/004) and POCI/AMB/55878/2004, several equipments were acquired aiming the full development, automatization and optimization of existing systems. This includes automatization in gamma spectrometry, modernization of the fast pneumatic system usually designated by SIPRA, introduction of Compton suppression in gamma spectrometry, implementation of PGAA (prompt gamma activation analysis), and automatic filter changing.

Results

The following figures show one of the two ASC2 automatic sampler changers acquired from Ortec. Each has autonomy for 48 samples to be measured in sequence automatically. The samples are in cylindrical containers which are automatically positioned for gamma spectrometry measurement.



Samples can be positioned at different distances from the germanium detector by placing rings. Gamma spectra in digital form enter the k_0 IAEA program for direct calculation of the concentrations. A Partisol Plus sequence air sampler was also acquired to collect

either PM10 or PM2.5 in sequence with autonomy for 16 filters. It is running at IST, and is shown in a figure below.



Steps were done to modernize the SIPRA system, as well as to finish the implementation of PGAA. Equipment for Compton suppression is partially at ITN, the remainder will come early 2007.

Published or in press work:

M.C. Freitas, A.M.G. Pacheco, M.A. Bacchi, I. Dionísio, S. Landsberger, J. Braisted, E. de Nadai Fernandes, Compton suppression INAA performance in determining trace and minor element contents in raw food items, *J. Radioanal. Nucl. Chem.* (in press).

M.G. Ventura, M.C. Freitas, A.M.G. Pacheco, T. van Meerten, H.Th. Wolterbeek, Selenium content in selected Portuguese foodstuffs, *Eur Food Res Technol* (in press).

Issmat Khan, *Internal report* on ASC2 functioning.

D. G. Beasley, *Internal report* on SIPRA functioning

(Bio) Assessment of elemental burden from selected atmospheric particulate matter's (PM's) size classes

R.M. Godinho, M.C. Freitas, H.Th. Wolterbeek¹, T.G. Verburg¹

The issue of this program is to relate lichen elemental occurrences to elemental occurrences in selected atmospheric size PM. This year work studied the short and long time element accumulation behavior of transplants of *Parmelia caperata* lichen thalli exposed at an atmospheric polluted area compared with total deposition. It was concluded that the lichen (transplant) elemental content does not unequivocally represent the average environmental availability of the exposure period. Reflection characteristics depend on the element, the lichen species, and the lichen physiological conditions. Resuming, lichens do not act like a measuring instrument; but present information on ambient element availability, somehow biased by biological effects. This result means that the design of a biomonitor experiment should involve transplants of similar and well-defined initial condition: here may be thought of similar morphology, well-characterized initial contents, and comparable physiological status quo. During the exposure, along with the lichen element content, lichen physiological parameters should be monitored throughout.

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Biomonitoring of trace element air pollution: links to emission sources and to human health

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The aim of the project is to investigate whether and which components and sources of air pollution may contribute to differences in cause-specific mortality in the Portuguese population. This is being achieved by means of cross-sectional comparisons between the regions that compose the territory of Continental Portugal. It is generally believed that some aspects of the chemical composition of air pollution are more important than others in triggering health effects and that present air pollution indicators such as PM are mere surrogates for these more active agents. This health study profits from the unique advantage provided by atmospheric biomonitoring in allowing high spatial sampling density over wide areas, and the fact that it allows determination of the concentration of numerous chemical elements, which in turn allows the use of multivariate statistical techniques such as factor analysis to identify and characterize emitting sources.

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Studies for the Evaluation of Selenium Levels in Typical Constituents of Portuguese Diets

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Selenium speciation methods with low detection limits are required to the accurate species quantification and identification. Atomic fluorescence spectrometry coupled to hydride generation was used to the determination of selenium species in fish samples (work developed at Jozef Stefan Institute, Ljubljana, Slovenia). Selenium daily intake was evaluated on small Portuguese population groups according to the duplicate portion method. The fast pneumatic system available on the Reactor facility was used to the determination of total selenium content in collected food samples through the short-lived nuclide ^{77m}Se.

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Impact of Atmospheric Aerosol in Human Health

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Questionnaires were distributed in basic schools of the city of Lisbon, concerning asthmatic, rhinitis, nutrition and environmental habits. The answers are being inter-correlated and correlated to an air sampler of PM2.5 placed at IST. It is known that particles, in particular the finest one, cause respiratory problems. This work aims to study the effect of PM2.5 and its composition in a school population. Sofar around 800 students were questioned in approximately 40 basic schools. Around 30% of the children present asthmatic and/or rhinitis.

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