

6.1. RESEARCH ACTIVITIES IN THE FIELDS OF RADIOCHEMISTRY AND NEUTRON ACTIVATION ANALYSIS USING THE LENA NUCLEAR PLANT IN PAVIA, L. Maggi, N. Genova, M. DiCasa, V. Carmella-Crespi (Pavia, Italy)

In the past two years the activity of the Radiochemistry Laboratory and CNR Centre of Radiochemistry and Activation Analysis was mainly devoted to studies of nuclear activation analysis applied to different fields using the LENA reactor.

Three NBS vegetable reference standards, Orchard Leaves, Tomato Leaves and Pine Needles, were analyzed for their halogen content (1).

Halogen determination in food stuff, vegetables and organic tissues gives valuable information on metabolic, nutritional, pollution and epidemiological fields.

Fluorine was determined by means of a method based upon spiking isotope dilution. After a wet attack of the samples in a high-pressure teflon-lined decomposition vessel, the resulting solutions were spiked with $^{18}\text{F}^-$; a constant amount of HF was absorbed on glass beads from the solutions and the $^{18}\text{F}^-$ content was determined by a gamma counting technique. Chlorine and bromine were determined by INAA. Iodine was isolated by distillation after digestion of the irradiated samples with chromic acid and reduction of iodate to volatile iodine. The 441 KeV photopeak of ^{128}I was used for analysis.

A detailed study on macro- and micro-elements content in Sardinian coal and its ashes was performed (2), in order to assess the possibility of using it as a fuel in electric power generating plants.

Instrumental neutron activation analysis was used for the determination of Al, Si, Mn, Mg, Na, V, Cl, Ce, Yb, Th, Cr, Hf, Cs, Se, Rb, Fe, Co, Ta, Eu, K, La and Sb. Aluminum and silicon were simultaneously determined with short irradiations

in a neutron flux with a fission energy spectrum after having determined aluminum with short irradiations in a thermal neutron flux. Short irradiation and quick counting were also used for the determination of Mn, Mg, V, Na and Cl.

A destructive neutron activation analysis method was used to determine As, Se and Br. After irradiation, the samples were attacked with a combustion method, the volatile elements were distilled, collected in a condenser and then analyzed by means of gamma spectrometry.

NBS-SRM 1632 "Coal" and NBS-SRM 1633 "Fly Ash" were used as standards.

A multielement trace analysis of rock samples was developed in cooperation with scientists from other Universities (3); the determination of R.E., U, Th, Zr, Cs, Ba, Ni, Sc, Ta, Hf, Sr, Cr by instrumental neutron activation analysis was carried out in connection with orogenetic studies of African Rocks.

Ce, Co, Cr, Cs, Eu, La, Ni, Sc, Ta in ophiolite standard gabbro GOG-1 (4) were also determined by instrumental neutron activation analysis.

In the archeological field ancient artifacts recently discovered during a digging campaign at Monza's Cathedral (Italy) were analyzed with the aim to trace their origin and compare their composition with similar samples whose dating is certain (5).

As a contribute to the international program of certifying NBS reference standard materials, chromium in the Brewer's Yeast, recently proposed as a new SRM, was determined by both instrumental and destructive neutron activation analysis (6). The samples were processed according to different methods.

In the study of the rôle and behaviour of trace elements in human physiology, vanadium was investigated in human blood, as a trace element of increasing interest in connection with its origin from pollutants (7). Preliminary radiotracer experiments injecting ^{48}V into rats indicated that vanadium is present in the blood serum as a V-transferrin biocomplex. In order to confirm these results proteins were isolated from human serum and then separated from each other by gel filtration on Sephadex resin. The vanadium content was measured in the elution fractions by neutron activation followed by ^{52}V gamma counting.

It was found that vanadium is mainly present in the plasma and in this fraction is mainly associated with transferrin the blood iron transport compound.

As an element of great interest in the life sciences, vanadium was also investigated in surface waters (8). Its different chemical forms were determined by passing the water samples through an ion exchange double-step system using both Chelex 100 and Dowex 1 x 8. Neutron activation analysis of each single fraction was carried out.

A stretch of the Po river, close to the site where the fourth Italian

nuclear power station is now operating, was submitted to environmental analysis in order to attain a thorough characterization of the river ecosystem before the beginning of the plant operation. This study mainly deals with the sampling and the analysis of the most significant components (water, suspended material and bottom sediments) of the river ecosystem affected by different pollution sources (industrial, agricultural and urban) (9).

Element analysis included the determination of iron, manganese, zinc, copper, nickel, lead, cadmium, cobalt, chromium, mercury, caesium, selenium and arsenic. Cs, Co, Cr, As, Se and Hg were determined by neutron activation analysis. Co, Cr and Cs were measured by INAA while As, Se and Hg were determined by destructive NAA.

A considerable part of the activity in progress at the CNR Centre of Radiochemistry and Activation Analysis deals with research programs carried out under international contracts with foreign authorities such as the National Bureau of Standard, USA, the International Atomic Energy Agency, Vienna and the Commission of the European Community, Bruxelles. Under these contracts a large amount of determinations using neutron activation analysis were performed on fish, carbon, fly ashes, sediments and vegetables, as a contribute to the certification of homogeneity and elemental composition of some standard materials.

Nuclear activation analysis was also applied to marine organism samples under a contract for oceanographic research program involving pollution control promoted by the National Research Council.

For a similar purpose, and also in order to correlate ^{the} arsenic, selenium and mercury contents, activation analysis of these elements in some marine organisms was performed (10).

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