

DISTRIBUTION MEASUREMENTS OF FLUORINE IN TOOTH ENAMEL

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In order to study the protective effect of fluoridation of teeth it is necessary to measure the distribution of fluorine in tooth enamel. We report our preliminary studies of the measurements of the fluorine distribution in tooth enamel, using the resonance $^{19}\text{F}(p,\alpha,\gamma)^{16}\text{O}$ reaction. It has strong and narrow resonances $E_p = 876$ keV ($\sigma = 661$ mb, $\Gamma = 5$ keV) and at $E_p = 935$ keV ($\sigma = 180$ mb, $\Gamma = 8,6$ keV), which can be easily excited by using our 2 MeV Van de Graaff proton accelerator.

The fluorine distribution is obtained by measuring the gamma-ray yield as a function of proton energy. The protons are slowed down in the target and react with fluorine where they reach the resonance energy. The principle of the measurement is outlined in Figs. 1, 2 and 3: If the fluorine concentration ρ_F is strong only on the surface (approximated by δ -function), the gamma-ray yield $N_\gamma(E_p)$ would reproduce the resonances, as it is shown in Fig. 1 below. If the fluorine concentration ρ_F would be constant and limited to narrow depth, as it is shown in Figs. 2 and 3 one should obtain the yield curves as are shown in Figs. 2 and 3 below.

An example of a measurement in tooth enamel is shown in Fig. 4, where the gamma-ray yield is shown as a function of depth. In the same figure the fluorine resonances are shown for comparison. The dotted line gives approximately the unnormalized density distribution of fluorine in a sample.

Further measurement and more detailed analysis are in progress.

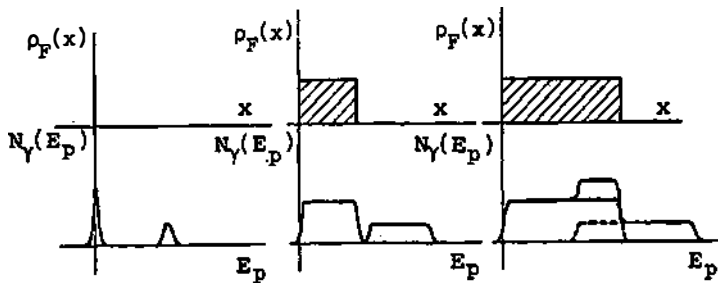


Fig. 1.

Fig. 2.

Fig. 3.

Figs. 1,2,3: The three hypothetical fluorine density distributions ρ_F and expected gamma-ray yields $N_\gamma(E_p)$

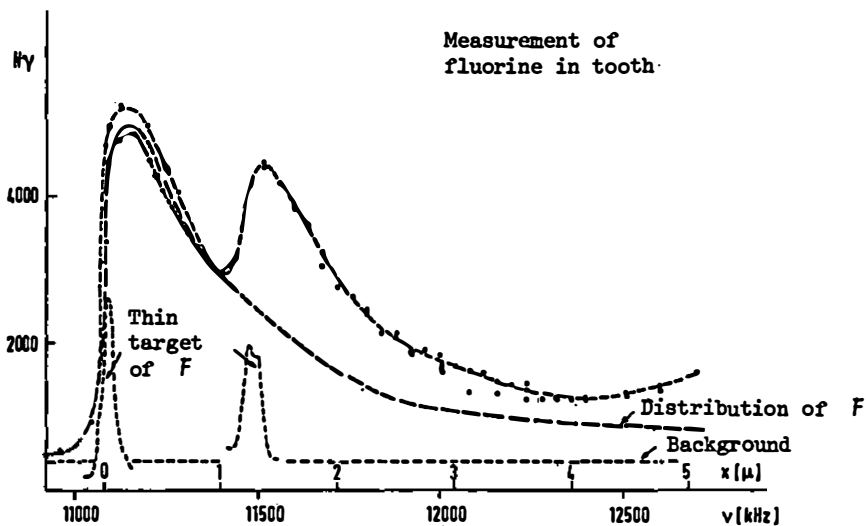


Fig. 4. The gamma-ray yield curves obtained by irradiating tooth enamel (dots) and unnormalized fluorine density distribution (broken line). The fluorine resonances are shown for comparison

MEASUREMENT OF TRACES OF ELEMENTS IN HUMAN HAIR
BY NEUTRON ACTIVATION ANALYSIS

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Samples of human hair (from 100 to 400 mg) taken from different persons were exposed to the beam of thermal neutrons in the nuclear reactor of the Institute "Jožef Stefan" at Ljubljana and were analysed in the Laboratory of Nuclear Spectroscopy of the Institute "Rudjer Bošković" at Zagreb.

16 elements were identified by the activation analysis using a $Ge(Li)$ detector of 20 cm^3 . These were as follows: Na, K, Cr, Co, Cu, Zn, Ge, As, Br, Rb, Ag, Cd, Sb, Au, Hg, Fe. The concentrations of 8 elements in μg per g of hair sample were determined (Table 1.).

Table 1.

Element	Samples		
	A	C	D
Na	140.0	30.0	87.0
Br	1.75	12.0	9.3
Au	0.09	0.06	0.15
Zn	370.0	4.0	9.0
As	3.2	1.4	0.8
Hg	0.6	2.0	0.9
Ag	1.0	1.1	0.3
Sb	0.8	0.3	0.6

Fig. 1. shows spectra of gamma rays of two irradiated hair samples from different persons. Comparison of the photo-peaks for five different samples are shown in Fig. 2. It is evident that there is a similarity between the samples belonging to the same person (C and C') and an obvious

difference between the samples belonging to different persons (A, C and D).

A very suitable method¹⁾ for sample identification is to compare the concentration ratio between a particular element and other elements in a given sample with the same concentration ratio in another sample. It is evident from Fig. 3. that the application of this analysis to only 7 photopeaks enables to determine which of the samples belong to the same person and which were taken from different persons.

It can be observed from our experiments that the concentrations of elements are different in the hair of diffe-

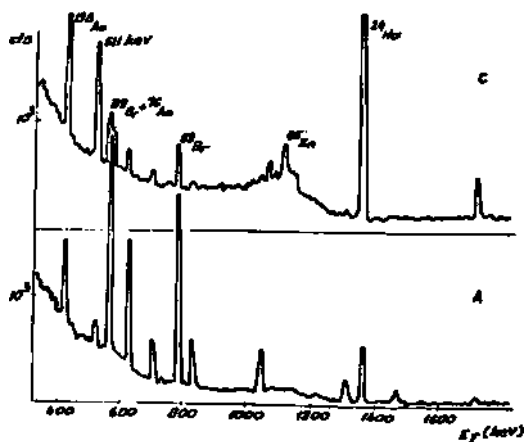


Fig. 1.

rent persons while the hair belonging to the same person is of

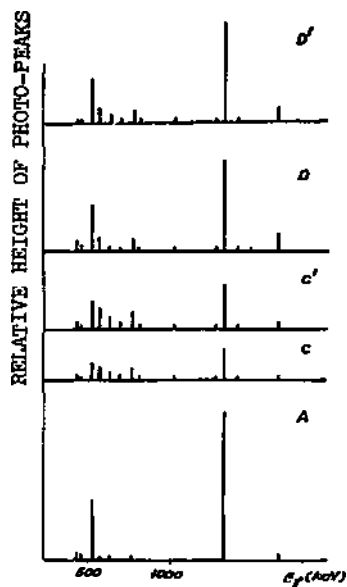


Fig. 2.

almost an equal composition.

Considerable concentration variations and a relatively large number of identified elements in the samples of

human hair make possible a successful application of these methods in criminology investigation for identification and particularly for elimination of some suspect person.

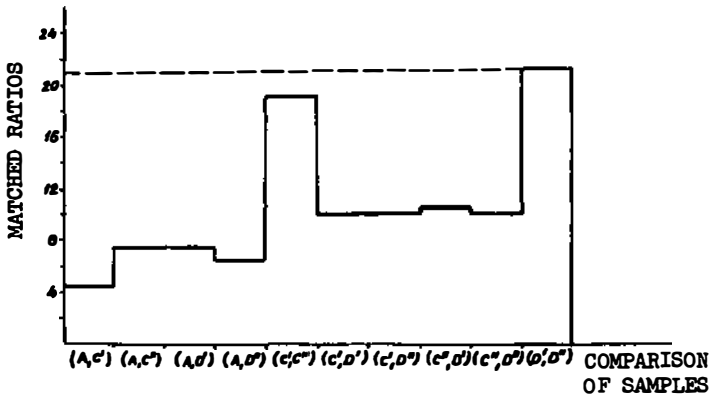


Fig. 3.

REFERENCES

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