APPLICATION OF THE TECHNIQUE FOR NUMERICAL SUBTRACTION OF THE MATRIX ELEMENT BACKGROUNDS IN THE NEUTRON ACTIVATION ANALYSIS OF METEORIC SUBSTANCE

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Key words: meteoric substance, neutron activation analysis, matrix elements

The complex technique of highly effective instrumental neutron activation analysis (INAA) for samples of any composition, realizing a numerical subtraction of matrix element gamma-ray spectra from gamma-ray spectra of complicate samples researched is used for the total analysis of a meteoric substance composition. A preliminary created database is used for isotopes of the individual element gamma-ray spectra measured on the equipment available at the researcher and then normalized to unit conditions such as a mass of an element, a flux of the neutrons used for an irradiation, and also unit values of time of an irradiation, cooling and measurement.

The technique developed does not change the traditional scheme of INAA including such stages of the analysis, as an irradiation of samples with neutrons, cooling, measurement and computer processing of spectra. The new technique is an additional part in the traditional computer processing the measured gamma-ray spectra consisting of search of peaks in a spectrum, comparison with peaks in spectra of reference materials and calculation of chemical element concentrations. The new stage of computer processing allows receiving additional analytical lines in gamma-ray spectra studied and higher signal-to-noise relations then ones for lines in spectrum received under the traditional computer processing.

A technique testing with use of the reference materials (such as FFA, ST, SGD, KH, etc.) is shown the greater similarity to the certificated values for element concentrations than ones before subtraction of matrix element influences. This is accomplished by "clearing" the basic analytical lines in a spectrum, i.e. increase signal-to-noise relations for overwhelming majority of lines in gamma-ray spectra (fig. 1).

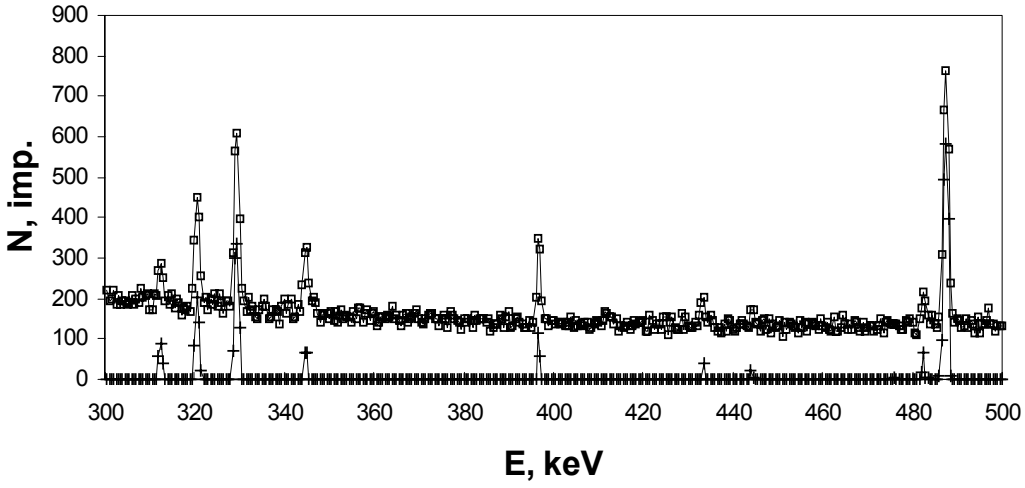

Fig. 1. The general view of fragment of a gamma-ray spectrum researched for a sample up to (□) and after (+) subtraction the Compton background of Scandium as a matrix isotope.

The technique presented was applied to the analysis of samples of chondrite meteorites, in which gamma-ray spectra prevails the matrix photopeaks of strongly activated elements, such as Sc, Co, Fe, characterized by the hard gamma-ray radiation creating the high Compton background in a low energy area (fig. 2).

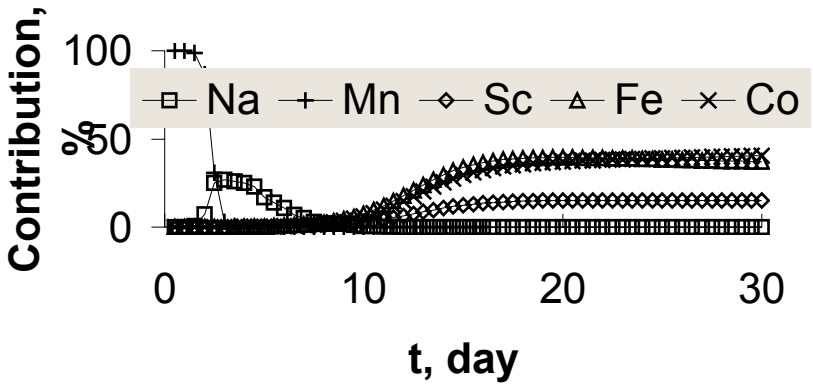

Fig. 2. Distribution of the matrix element contributions to total activity of the sample researched for Allende meteorite within 30 days after an irradiation.

As a result of spectra processing of Allende meteorite by the given technique the additional data on trace element concentrations such as Ce, Nd, Sm, Eu, Gd, Tb, Yb, Lu, Zn, Se, Ba, Hf, Ta, etc. are received and also the determination errors are reduced for some photopeaks, including peaks with intensity at the detection limits (Sb, As, Gd, Lu, see the table).

Consecutive subtraction of matrix element gamma-ray spectra from a complex gamma-ray spectrum of sample analyzed allows to increase number of elements determined within the limits of the list theoretically elements determined in INAA; the opportunity of line additional detections depends on the composition and a relationships of matrix elements in each concrete sample researched.

Table. Element composition for Allende chondrite (CV3) (Ca, Fe and Ni - %, other elements – mkg / g): a) results INAA; b) results INAA after a deduction of Compton background; c) certified values [1].

Element	*a*	*b*	*c*	Element	*a*	*b*	*c*
Na	3600		3400	Sb	<0.35	0.10	0.085
Ca,%	1.85		2	Cs	<0.2	<0.1	0.094
Sc	11.2	10.2	11.8	Ba	<32	6.7	4
Cr	3580	3850	3690	La	0.50	0.48	0.52
Fe,%	23.4	21.9	22.3	Ce	<4	1.45	1.29
Ni,%	1.38	1.36	1.42	Nd	<3	1.2	0.99
Co	680	715	692	Sm	0.31	0.33	0.34
As	<1.9	1.75	1.60	Eu	0.10	0.10	0.11
Au	0.146	0.155	0.15	Gd	<1.0	0.46	0.42
Ir	0.81	0.72	0.76	Tb	<0.15	0.095	0.081
Zn	122	98	110	Yb	0.33	0.35	0.30
Se	9.5	7.6	8.2	Lu	0.055	0.048	0.052
Rb	<10	1.7	1.2	Hf	<0.6	0.31	0.22
Zr	<15	8.4	7.6				

Reference

1. *Wasson J.T., Kallemeyn G.W.* // Phil. Trans. R. Soc. Lond., A325. 1988. PP. 535-544.

Electronic Scientific Information Journal "Herald of the Department of Earth Sciences RAS" № 1(22)'2004
Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2004
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2004/informbul-1_2004/planet-13e.pdf
Published on 1, July, 2004