

## DETERMINATION OF TRACE ELEMENTS IN SOIL

Maria Sălăgean, Ana Pantelică  
Institute for Physics and Nuclear Engineering  
Bucharest MG-6, Romania

Abstract: Concentration of 32 elements in reference material SOIL-7 is determined

## INTRODUCTION

The work described in this paper was the subject of an intercomparison organised by IAEA's Analytical Quality Control Service on the determination of trace elements in soil materials (Soil-7 collected near Ebensee in Upper Austria) in order to provide a reference material for multielement analyses and also to verify the performance of different analysis methods of the participating laboratories.

The composition of soil is of interest for the specialists in various fields of research as geology, biology, nutrition and environmental pollution. A number of 56 laboratories from 25 countries using different methods of analysis sent their results at this intercomparison. Activation analysis was the most frequent method used (38 % of all determinations).

## EXPERIMENTAL

By using the instrumental neutron activation analysis method the concentration of 32 elements has been determined in our laboratory.

The concentration of Ba, Ca, Ce, Co, Cs, Cr, Eu, Fe, Hf, La, Lu, Nd, Rb, Sb, Sc, Sm, Sr, Ta, Tl, Th, U, Yb, Zn, Zr have been determined after 50 hours irradiation time in a thermal neutron flux of  $1.1 \times 10^{11} \text{ n/cm}^2 \cdot \text{s}$ .

The samples ( $\sim 150 \text{ mg}$  in weight) and Soil-5, SI-1, GSP-1 as standards have been measured 2 - 5 hours after  $10 \pm 30$  days.

In a pneumatic tube with a  $10^{12} \text{ n/cm}^2 \cdot \text{s}$  flux the samples and W-1 standard material have been irradiated for 1 - 3 minutes. After 6 min. - 24 hours decay time the samples were measured for 100 - 1800 s. The concentration of Al, Dy, Eu, K, Mg, Mn, Na, Sm, Ti, V was in this way determined. In both types of irradiation the concentration values are the arithmetic average of the values for 4 independent determinations.

A multichannel analyser connected to a  $65 \text{ cm}^3 \text{ Ge(Li)}$  detector with 2 keV resolution was used.

## RESULTS AND DISCUSSION

The results for the concentration of the elements thus determined are presented in table 1.

These values are classified by the IAEA (column 5) as recommended values with satisfactory (A) or acceptable (B) degree of confidence and information values - non-certified (C).

For the major elements Al, Ca, Fe, Mg, K, Na and Ti their values pass all the test criteria of class A but their confidence intervals are larger than those usually required for major components of reference materials. These values can not be certified but may be used as reference values in the cases in which these too large confidence intervals do not cause problems in future analytical works. These elements are denoted by A\*.

Our results shown in table 1 are in a good enough agreement with the results presented by IAEA except for U and Sr concentration. In this case our value was rejected by statistical test. For Ca and Zn our values of concentration have been taken into account in the estimation of the results although these values are outside of confidence intervals.

TABLE 1

Element	Concentration (ppm)	Confidence intervals	Our results	Class of results
0	1	2	3	4
Al(%)	4.7	4.4 - 5.1	$4.2 \pm 0.1$	A*
Ba	159	131 - 196	$195 \pm 16$	C
Ca(%)	16.3	15.7 - 17.4	$11.6 \pm 0.2$	A*
Ce	61	50 - 63	$53 \pm 1$	B
Co	8.9	8.4 - 10.1	$9.2 \pm 0.2$	A
Cr	60	49 - 74	$64 \pm 1$	B

0	1	2	3	4
Cs	5.4	4.9 - 6.4	5.2 ± 0.2	B
Dy	3.9	3.2 - 5.3	3.3 ± 0.2	B
Fu	1.0	0.9 - 1.3	1.05 ± 0.13	B
Fe(%)	2.57	2.52 - 2.63	2.56 ± 0.05	A*
Hf	5.1	4.8 - 5.5	4.7 ± 0.2	A
K(%)	1.21	1.13 - 1.27	1.28 ± 0.05	A*
La	28.0	27.0 - 29.0	28.3 ± 0.4	B
Lu	0.3	0.1 - 0.4	0.34 ± 0.01	C
Mg(%)	1.13	1.10 - 1.18	1.11 ± 0.14	A*
Mn	631	604 - 650	605 ± 16	A
Na(%)	0.24	0.23 - 0.25	0.223 ± 0.004	A*
Nd	30	22 - 34	31 ± 2	B
Rb	51	47 - 56	49 ± 4	A
Sb	1.7	1.4 - 1.8	1.77 ± 0.10	B
Sc	8.3	6.9 - 9.0	8.4 ± 0.1	B
Sm	5.1	4.8 - 5.5	5.5 ± 0.2	B
Sr	108	103 - 114	161 ± 17	B
Ta	0.8	0.6 - 1.0	0.58 ± 0.13	B
Tb	0.6	0.5 - 0.9	0.85 ± 0.13	B
Th	8.2	6.5 - 8.7	8.03 ± 0.10	B
Ti(%)	0.3	0.26 - 0.37	0.26 ± 0.03	A*
U	2.6	2.2 - 3.3	0.91 ± 0.12	A
V	66	59 - 73	54 ± 5	A
Yb	2.4	1.9 - 2.6	2.4 ± 0.1	B
Zn	104	101 - 113	161 ± 10	A
Zr	185	180 - 201	185 ± 26	A