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Neutron Activation Analysis of Some Water Sources Around Khorram Abad, Lorestan, Iran

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Sampling from 20 points of water sources around Khorram Abad zone area spreading about 500 km^2. Samples are selected in order to standard volume. All the samples were dried by the slowly vapourization, to find their deposits and mineral elements. Activation under neutron beam in Tehran Research Reactor at neutron flux 5×10^{13} n/cm^2 s and γ spectro-scopy has been concluded the kinds of elements and their relative quantity.

Key Words: Water sources, Elements, Neutron activation.

INTRODUCTION

Water sources around the city Khorram Abad has main role in human beings and is used for domestic animals and often irrigating farms[1,2]. Information about containments and soluble elements is necessary for optimum use of growing plants and raising domestic animals and healthcare of urbans. The productivity of fresh water is highly dependent upon the quantity and quality of the water supply.

Greater capacity to affect such analysis needs to be develop wherever such information will assist in improving the quality of decision making about water use and its impact of some other activities like fishery. In the first step, an area of about 500 km^2 was chosen to measure the water quality especially heavy metals and trace elements. From 20 springs and running water samples were collected and minerals were measured.

EXPERIMENTAL

The water samples each 2 L have been collected from flowing water springs. The samples were taken in pre-washed plastic can. All the samples were vacuum dried at normal atmosphere pressure and for between 40 to 70 h.

After drying samples and separating remained solid the glass flask was washed by 2-3 mL of nitric acid. The residue was then left till the acid is completely evaporated.

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TABLE-1
ELEMENTAL CONTENT OF WATER SAMPLES COLLECTED IN AND AROUND KHORRAM ABAD, IRAN

No.		W1 (ppm)	W2 (ppm)	W3 (ppm)	W4 (ppm)	W5 (ppm)	W6 (ppm)	W7 (ppm)	W8 (ppm)	W9 (ppm)	W10 (ppm)
1	Al	228±6	–	–	159±8	186±6	–	–	94±5	133±5	–
2	Ba	162±8	<15	147±6	94±12	164±8	–	284±16	50±4	116±6	37±12
3	Br	4.5±0.5	27±2	6.5±0.5	6.5±0.8	10±1	–	7.1±0.4	4.2±0.2	9.3±0.5	4.5±0.5
4	Ca*	12.2±0.2	–	9.5±0.3	9.7±0.3	12.1±0.2	–	–	12.5±0.5	11.5±0.3	–
5	Ce	0.99±0.08	<0.5	1±0.1	0.74±0.07	0.56±0.09	–	<0.2	0.2±0.02	0.61±0.07	0.21±0.04
6	Cl	<60	–	<60	<60	<60	–	–	<60	<60	<60
7	Co**	2.9±0.2	54±14	23±4	31±4	<20	33±8	<20	12±3	<20	28±3
8	Cr	0.11±0.02	<0.4	8.4±0.3	5.5±0.5	0.82±0.24	3.5±0.5	<0.5	0.49±0.09	<0.5	0.28±0.07
9	Cs	0.11±0.02	<0.1	<0.05	0.29±0.02	<0.05	<0.2	0.98±0.04	0.49±0.03	<0.05	<0.05
10	Fe	42±3	<30	17±5	42±4	<30	<150	18±2	<20	<30	<20
11	Hf	0.63±0.04	<0.1	0.83±0.04	1.3±0.1	1.3±0.1	0.40±0.05	0.77±0.03	0.25±0.02	1.2±0.1	0.021±0.004
12	La	0.73±0.06	<0.2	1.1±0.1	0.73±0.06	0.92±0.08	–	0.37±0.08	0.27±0.06	0.82±0.07	0.24±0.03
13	K*	0.074±0.014	–	0.153±0.033	0.112±0.035	117±0.032	–	–	0.236±0.005	0.113±0.022	–
14	Mg*	2.1±0.1	–	–	2.9±0.2	2.9±0.2	–	–	1.7±0.2	3.7±0.2	–
15	Mn	<5	–	<5	<5	<5	–	<5	<5	<5	–
16	Na*	2.8±0.2	–	2.3±0.2	2±0.1	1±0.1	–	–	–	1±0.1	–
17	Rb	<2	<0.2	<2	<2	<2	–	7.1±0.9	1.5±0.3	<2	<20
18	Sb**	59±8	<200	35±7	47±8	<50	122±32	53±7		47±10	17±6
19	Sc**	14±2	<10	8±2	21±2	13±2	38±6	8±1	3.8±0.2	9.5±0.6	1±0.2
20	Sm	<0.1	<0.10	<0.1	<0.1	0.13±0.01	–	<0.1	0.033±0.006	0.098±0.009	0.36±0.04
21	Sr*	0.136±0.003	0.0102±0	0.179±0.005	0.111±0.003	0.154±0.003	0.0639±0.005	0.128±0.005	0.039±0.004	0.128±0.004	0.0258±0.008
22	U	1.2±0.1	<0.5	1.7±0.1	1.1±0.1	1.7±0.1	1.2±0.2	0.29±0.05	0.45±0.05	1.2±0.1	0.42±0.05
23	Th	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.05
24	Zn	7.5±0.5	<2	59±3	4±0.2	20±2	24.5±2.5	10.5±0.5	4.5±0.2	17.5±1.5	11.5±0.5
25	V	2.7±0.1	–	–	8.7±0.2	6.7±0.2	–	–	1.7±0.1	6.2±0.2	–
mg/L	Solid	350	3283	440	326	490	350	350	344	295	12271

No.		W11 (ppm)	W12 (ppm)	W13 (ppm)	W14 (ppm)	W15 (ppm)	W16 (ppm)	W17 (ppm)	W18 (ppm)	W19 (ppm)	W20 (ppm)
1	Al	74±5	–	–	159±8	186±6	–	–	94±5	133±5	–
2	Ba	163±6	<15	147±6	94±12	164±8	–	284±16	50±4	116±6	37±12
3	Br	2.4±0.2	27±2	6.5±0.5	6.5±0.8	10±1	–	7.1±0.4	4.2±0.2	9.3±0.5	4.5±0.5
4	Ca*	10.2±0.2	–	9.5±0.3	9.7±0.3	12.1±0.2	–	–	12.5±0.5	11.5±0.3	–
5	Ce	0.78±0.07	<0.5	1±0.1	0.74±0.07	0.56±0.09	–	<0.2	0.2±0.02	0.61±0.07	0.31±0.04
6	Cl	<60	–	<60	<60	<60	–	–	<60	<60	<0.60
7	Co**	41±4	54±14	23±4	31±4	<20	33±8	<20	12±3	<20	28±3
8	Cr	4.1±0.2	<0.4	8.4±0.3	5.5±0.5	0.82±0.24	3.5±0.5	<0.5	0.49±0.09	<0.5	0.28±0.07
9	Cs	1.2±0.1	<0.1	<0.05	0.29±0.02	<0.05	<0.2	0.98±0.04	0.49±0.03	<0.05	<0.05
10	Fe	28±3	<30	17±5	42±4	<30	<150	18±2	<20	<30	<20
11	Hf	0.77±0.03	<0.1	0.83±0.04	1.3±0.1	1.3±0.1	0.40±0.05	0.77±0.03	0.25±0.02	1.2±0.1	0.021±0.004
12	La	1±0.1	<0.2	1.1±0.1	0.73±0.06	0.92±0.08	–	0.37±0.08	0.27±0.06	0.82±0.07	0.24±0.03
13	K*	<0.1	–	0.153±0.033	112±0.035	117±0.032	–	–	0.236±0.005	0.113±0.022	–
14	Mg*	3.1±0.1	–	–	2.9±0.2	2.9±0.2	–	–	1.7±0.2	3.7±0.2	–
15	Mn	<5	–	<5	<5	<5	–	<5	<5	<5	–
16	Na*	5±0.2	–	2.3±0.2	2±0.1	1±0.1	–	–	–	1±0.1	–
17	Rb	3.9±0.3	<0.2	<2	<2	<2	–	7.1±0.9	1.5±0.3	<2	<20
18	Sb**	133±12	<200	35±7	47±8	<50	122±32	53±7		47±10	17±6
19	Sc**	16±2	<10	8±2	21±2	13±2	38±6	8±1	3.8±0.2	9.5±0.6	1±0.2
20	Sm	0.14±0.07	<0.10	<0.1	<0.1	0.13±0.01	–	<0.1	0.033±0.006	0.098±0.009	0.36±0.04
21	Sr*	0.197±0.004	0.0102±0	0.179±0.005	0.111±0.003	0.154±0.003	0.0639±0.005	0.128±0.005	0.039±0.004	0.128±0.004	0.0258±0.008
22	U	1.6±0.1	<0.5	1.7±0.1	1.1±0.1	1.7±0.1	1.2±0.2	0.29±0.5	0.45±0.05	1.2±0.1	0.42±0.05
23	Th	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.05
24	Zn	23±2	<2	59±3	4±0.2	20±2	24.5±2.5	10.5±0.5	4.5±0.2	17.5±1.5	11.5±0.5
25	V	6.2±0.2	–	–	8.7±0.2	6.7±0.2	–	–	1.7±0.1	6.2±0.2	–
mg/L	Solid	350	3283	440	326	490	350	350	344	295	12271

*%, **ppb

'–' Either too low or overshadowed by Compton peaks of higher energy

'<' element is in the sample but not exactly measurable, but it is less than given value.

Irradiation and analysis: The residual solids was divided into two portions. One was irradiated in the Tehran Research Reactor with thermal neutron flux of 5×10^{13} n/cm^2 s for short time up to 30 s to measured short-lived radionuclide irradiation. For long-lived radionuclides were carried out for average of 2 h. After irradiation the short-lived radio nuclides were immediately measured with high precise germanium detector[3]. Each sample was measured three times whose average was given in the Tables-1.

The elemental analysis was done using a PC build on software, which token in to account all sources of errors, including systematic errors, statistical errors, background and self absorption.

RESULTS AND DISCUSSION

In elemental analysis the followings are taken into account. (1). Low and very low amounts (ppm and ppb) of some elements. (2). High amount percentage of Ca, K, Mg, Na, Sr (19 out of 20 samples). In most samples uranium is much higher than standard. (3). In some γ-spectra the weak photo peaks were over shadowed. Compton peak of strong photo peaks and therefore the relevant element could not be determined precisely, therefore they are given as dotted line. (4). In some samples because of high proportion of elements such as Ca, K, Mg, Na and Sr minor elements could not be exactly determined. They are given as less then a predictable value.

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