



Table I. Neutron Activation and X-ray Fluorescence Analysis of JG-1 and Sanshiro Pond Sediment

Element	Nuclide	$\gamma$ -ray (keV)	JG-1			Sanshiro Pond Sediment Content	Method
			Determined Content	Average	Reported Range		
Fe	Fe-59	1099.0	1.45 ± 0.05 (9)%	15.3 %	1.36 ~ 1.76%	6.37 ± 0.12 (10)%	NAA
Na	Na-24	1368.6	2.46 ± 0.11 (5)	2.51	2.33 ~ 2.66	0.537 ± 0.014 (10)	NAA
K						0.715 ± 0.018 (15)	XRF
Ca						0.620 ± 0.011 (14)	XRF
Ti						0.673 ± 0.013 (15)	XRF
Sm	Sm-153	103.18	5.60 ± 0.4 (7)ppm	4.6 ppm	4.15 ~ 5.6 ppm	5.17 ± 0.14 (9)ppm	NAA
Ce	Ce-141	145.43	55 ± 6 (9)	43.2	41.9 ~ 47	41.2 ± 1.6 (10)	NAA
Lu	Lu-177	208.34	0.64 ± 0.08 (7)	0.36	0.22 ~ 0.52	0.30 ± 0.02 (10)	NAA
U	Np-239	277.63	3.53 ± 0.18 (5)	3.3	2 ~ 4.67	1.66 ± 0.25 (10)	NAA
Th	Pa-233	311.98	14.5 ± 1.20 (5)	13.5	11.5 ~ 15.6	5.77 ± 0.27 (10)	NAA
Cr	Cr-51	320.07	69.7 ± 20.0 (5)	52.7	31 ~ 64	74.2 ± 3.8 (10)	NAA
Hf	Hf-181	482.0	3.59 ± 0.25 (9)	3.3	3.1 ~ 3.8	3.55 ± 0.31 (10)	NAA
Yb	Yb-169	197.95	3.08 ± 0.40 (7)		1.45 ~ 2.5	2.14 ± 0.19 (10)	NAA
Au	Au-198	411.8	—	—	—	0.09 ± 0.01 (10)	NAA
Ba	Ba-131	496.23	508 ± 60 (5)	462	430 ~ 603	324 ± 56 (10)	NAA
Sb	Sb-122	564.10	0.66 ± 0.20 (3)		0.1 ~ 2.0	2.35 ± 0.12 (10)	NAA
As	As-76	559.1	—	—	—	10.5 ± 1.0 (10)	NAA
Br	Br-82	776.5	—	—	—	15.3 ± 0.7 (5)	NAA
Cs	Cs-134	795.76	10.3 ± 0.50 (5)	10.1	9.3 ~ 10.6	3.87 ± 0.42 (10)	NAA
Mn	Mn-56	846.6	489 ± 13 (3)	472	433 ~ 557	787 ± 8 (5)	NAA
Sc	Sc-46	889.25	6.36 ± 0.26 (9)		6.44 ~ 8.0	26.3 ± 0.4 (10)	NAA
Rb	Rb-86	1078.80	192 ± 15 (5)	181.3	171 ~ 202	47.6 ± 5.9 (10)	NAA
Co	Co-60	1173.21	3.05 ± 0.30 (9)	6.4	2 ~ 28	26.6 ± 0.9 (10)	NAA
Ta	Ta-182	1221.38	—	—	—	[0.4]	NAA
Eu	Eu-152	1408.02	0.46 ± 0.03 (7)	0.69	0.62 ~ 0.75	0.89 ± 0.06 (10)	NAA
La	La-140	1596.40	23.2 ± 1.9 (7)	22.1	18 ~ 22.5	18.0 ± 0.6 (10)	NAA
Ni						31 ± 3 (10)	XRF
Cu						236 ± 2 (10)	XRF
Zn						379 ± 6 (10)	XRF
Sr						113 ± 2 (10)	XRF
Pb						118 ± 1 (10)	XRF

NAA: Neutron activation analysis, XRF: X-ray fluorescence analysis

( ): Number of determinations, [ ]: Rough estimation

The contents of the Sanshiro Pond sediment are based on the material dried at 110°C for 4 hrs.

## Neutron Activation and X-ray Fluorescence Analysis of Geological SRM

cross sections, resonance integrals, half-lives, etc. stored in a file, after evaluating neutron spectrum with monitors irradiated together with samples.<sup>1)</sup>

### 2) X-ray Fluorescence Analysis.

X-ray fluorescence analysis was performed by a non-destructive method which utilizes internal standards such as Se and Cs of known amounts preliminarily well mixed with samples. Details are already reported elsewhere.<sup>2)</sup>

Both the methods described above do not require individual primary standards corresponding to elements to be determined in samples. Therefore, chance errors on making complicated mixtures can be eliminated.

### 3) Result.

In Table I results are shown. In case of JG-1, GSJ have been compiling data obtained by different analytical methods and from people from different disciplines.<sup>3)</sup> For reference, recommended values by GSJ and ranges of reported values are cited. Pretty good agreements were obtained for most of the elements except for the cobalt concentration. Since cobalt is one of elements which are easily and accurately determined by neutron activation analysis, the value presented in this work is more accurate than the recommended. Chromium concentrations determined by neutron activation sometimes become twice as much as that of the recommended. The reason for this is not clear. Contamination of the elements during the sample preparation and irradiation is very unlikely, since blank runs so far examined never exhibited significant amounts of those elements listed in Tables.

Concentrations listed for Sanshiro Pond Sediment are corrected for 10.4 percent of the water content which was measured independently by drying samples at 110°C. Good reproducibility of the analytical data of the SRM suggests that the sample is homogeneous enough to be used to the practical purpose.

## REFERENCES

- (1) M. Koyama and R. Matsushita, *Bull. Inst. Chem. Res., Kyoto Univ.*, **58**, 235 (1980).
- (2) T. Takamatsu, *Bunseki Kagaku*, **27**, 193 (1978).
- (3) A. Ando, H. Kurasawa, T. Ohmori, and E. Takeda, *Geochem. J.*, **8**, 175 (1974).