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1991 compilation of analytical data for silver, gold, palladium and platinum in twenty-six GSJ geochemical reference samples

Shigeru TERASHIMA*, Shiro ITOH* and Atsushi ANDO**

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Abstract: Analytical data for silver, gold, palladium and platinum, received by July 1991 on twenty-six GSJ (Geological Survey of Japan) geochemical reference samples in which seventeen are "Igneous rock series" and nine are "Sedimentary rock series" have been preliminarily compiled. The received data (communicated and published) were evaluated under the consideration of analytical methods and procedures. Based on the selected available data, means and standard deviations have been calculated and presented as the 1991 values for some samples.

1. Introduction

The Geological Survey of Japan (GSJ) has issued 26 geochemical reference samples for the determination of major, minor, isotopic compositions and isotopic ages so far. Recent compilations of the analytical data for the samples have been published by Ando *et al.* (1989) and Govindaraju (1989). However, the reference values of siver and gold is given only for a few standard samples. Moreover, any available data of palladium and platinum is not found in a previous compilation table. Although more than 270 geochemical reference samples have been issued from many countries worldwide, available data dealt with the precious metals are restricted without older reference samples (Govindaraju, 1989).

Silver, gold, palladium and platinum abundances in geological materials have the important bearing on metal geochemistry and of great economic interest as mineral resources. Recently, the authors have developed a rapid and sensitive method for the determination of silver (Terashima, 1991a), gold (Terashima *et al.,* 1992), palladium and platinum (Terashima, 1991b) in geological materials by graphite furnace atomic absorption spectrometry, which has been applied for analyses of 26 GSJ and other international geochemical reference samples.

In this paper, we evaluate all analytical results received by July 1991 for silver, gold, palladium and platinum, and a set of the 1991 values for the elements is presented for the 26 GSJ geochemical reference samples.

2. Note on the samples

The sample processing method, sampling location and description of the 26 GSJ geochemical reference samples including the 17 "Igneous rock series" and the 9 "Sedimentary rock series" have been described in previous papers (Ando *et al.,* 1987, 1989 and 1990; Terashima *et al.,* 1990). The sample description and our analytical data for silver, gold, palladium and platinum, and previously compiled copper and silicon dioxide values

*Geochemistry Department

**Present address: Japan Resources Observation System Organization, Nishi-shinbashi, Tokyo.

Keywords: rock reference sample, compilation value, silver, gold, palladium, platinum, precious metal

Table 1 Sample descriptions and analytical data for Ag, Au, Pd, Pt, Cu and SiO_{y2} in 26 GSJ geochemical reference samples.

Sample		Ag (ppb) Terashima (1991b)	Au (ppb) Terashima *et al.* (1992)	Pd (ppb) Terashima (1991a)	Pt (ppb) Terashima (1991a)	Cu (ppm)* Ando *et al.* (1989)	SiO_2 (%)* Ando *et al.* (1989)
"Igneous rock series"							
JA-1	Andesite	40	0.18	<0.2	0.5	42.2	64.06
JA-2	Andesite	38	0.25	0.5	1.3	28.6	56.18
JA-3	Andesite	74	1.05	1.1	1.7	45.3	62.26
JB-1	Basalt	44	0.85	0.7	1.6	56.3	52.17
JB-1a	Basalt	38	0.86	0.6	1.6	55.5	52.16
JB-2	Basalt	72	5.36	6.6	4.0	227	53.20
JB-3	Basalt	55	2.06	3.3	4.3	198	51.04
JF-1	Feldspar	17	0.11	<0.2	<0.5	0.2	66.64
JF-2	Feldspar	20	0.12	<0.2	<0.5	0.3	65.20
JG-1	Granodiorite	26	0.13	<0.2	<0.5	1.5	72.30
JG-1a	Granodiorite	21	0.15	<0.2	<0.5	1.3	72.19
JG-2	Granite	17	0.08	<0.2	<0.5	0.4	76.95
JG-3	Granodiorite	25	0.17	<0.2	<0.5	6.0	67.10
JGb-1	Gabbro	25	1.06	<0.2	<0.5	86.8	43.44
JP-1	Peridotite	1.5	0.35	1.2	4.0	5.7	42.39
JR-1	Rhyolite	31	0.18	<0.2	<0.5	1.4	75.41
JR-2	Rhyolite	21	0.14	<0.2	<0.5	1.4	75.65
"Sedimentary rock series"							
JCh-1	Chert	4.1	0.13	0.4	<0.5	15.5	98.02
JDo-1	Dolomite	1.9	0.09	<0.2	<0.5	1.4	0.20
JLk-1	Lake sediment	205	4.59	3.0	1.4	59.8	57.09
JLs-1	Limestone	1.3	0.07	<0.2	<0.5	< 0.5	0.11
JSd-1	Stream sediment	36	0.93	0.5	<0.5	22.2	66.42
JSd-2	Stream sediment	1040	54.6	21.2	16.7	1114	60.27
JSd-3	Stream sediment	3010	5.66	3.2	1.3	426	75.36
JSl-1	Slate	119	0.93	0.8	1.3	40.0	59.35
JSl-2	Slate	61	0.92	1.3	1.5	40.8	59.26

*Cu and SiO_2 data for "sedimentary rock series" from Terashima *et al.* (1990)

are summarized in Table 1.

Among the samples, exceptionally high amounts of the precious metals are found in a stream sediment reference sample, JSd-2, which was collected from the river near the Hitachi Copper Mine. Therefore, this significant anomaly may be related to the mineralization of the source rocks. Silver content of the stream sediment JSd-3 (3010 ppb) is the highest in all GSJ reference samples. This anomalous value may be also related to the mineralization because the sample was taken from the streams around the Takatori Sn-W Mine. As for the igneous rock reference samples, basaltic rocks are generally rich in gold, palladium and platinum. Especially, gold and palladium contents of JB-2 (Oshima volcano) and JB-3 (Fuji volcano) are clearly higher than those of other samples, and the precious metals and copper are correlated positively in most cases (Table 1). Palladium and platinum in granitic rocks, feldspars, rhyolite, dolomite and limestone samples are less than the detection limits of 0.2 ppb and 0.5 ppb and for palladium and platinum, respectively.

3. Evaluation of the reported data

We have reported from 36 laboratories

Table 2 Comparison of silver values in six USGS geochemical exploration reference samples in ppm.

Sample	Recom. V. Gladney *et al.* (1990)	AAC Terashima (1991b)	AAC Ebarvia *et al.* (1988)	AAC Viets *et al.* (1984)	AAC Viets (1978)
GXR-1	31±4	33.60	>5	30.8	34
GXR-2	17±3	16.95	>5	17.2	17.5
GXR-3	2.4±1.1	0.059	0.08	0.11	0.10
GXR-4	4.0±1.0	3.60	3.4	3.34	3.7
GXR-5	1.4±0.6	0.740	0.76	0.73	0.82
GXR-6	1.3±0.6	0.298	0.28	0.31	0.32

Recom. V.: Recommended value. AAC: Atomic absorption proceeded by chemical separation.

Table 3 Comparison of the results in aqua regia digestion (A) and aqua regia with HF digestion (B) in selected six reference samples.

Sample	Au (ppb)		Pd (ppb)		Pt (ppb)	
	(A)	(B)	(A)	(B)	(A)	(B)
JB-1	0.65	0.85	0.5	0.7	0.6	1.6
JB-2	4.56	5.36	5.9	6.6	2.5	4.0
JB-3	1.91	2.06	2.9	3.3	2.5	4.3
JLk-1	3.60	4.59	3.1	3.0	1.2	1.4
JP-1	0.09	0.35	0.9	1.2	2.1	4.0
JSd-2	51.1	54.6	21.5	21.2	10.0	16.7

Data from Terashima (1991a) and Terashima *et al.* (1992)

worldwide (17 publications and 19 personal communications, total 373 data) on silver, gold, palladium and platinum of 26 GSJ reference samples. All reported data are tabulated in appendix (Table A-1) with references for individual data. Analytical method codes are given in Table A-2.

Recommended values for all elements were generally proposed by calculating the mean, after eliminating data lying out of the range which are two times greater than the standard deviation (Ando *et al.*, 1989; Gladney and Roelandts, 1990). In some cases, however, the method gives unreasonable values for several elements. For example, the recommended values for silver in six geochemical exploration reference samples GXR-1 to GXR-6 are listed in Table 2 for comparison with the analytical data found in some literatures, which were obtained by atomic absorption spectrometry proceeded by chemical separation. From the table it can be noticed that the recommended values for GXR-3, GXR-5 and GXR-6 are significantly higher than those reported in the literatures. The discrepancies in silver content of the GXR might be derived from large number of atomic absorption spectrometric analyses without chemical separation and background absorbance correction, which led to the higher results (Terashima, 1991b). In this study, therefore, the extraordinarily high or low values of silver, gold, palladium and platinum reported are excluded on statistical calculation.

Although the method of aqua regia digestion is very rapid and convenient for routine work and has been widely accepted for precious metal analyses, the analytical results from the aqua regia digestion only often showed clearly lower values for most samples, if compared with the results in the case of the aqua regia plus hydrofluoric acid digestion (Table 3). From this reason, the values obtained by the AAS with only aqua regia digestion are also excluded from the calculation.

The 1991 values listed in Table 4 are compiled by means of calculating the mean and standard deviation when the number of available data is more than four; when it is less than three the range or individual datum is presented. Because number of available analytical data is still few, the compiled values are likely to be tentative for several samples. Especially palladium and platinum values are mostly derived from the author's data obtained by the graphite furnace atomic absorption spectrometry after digestion of sample with aqua regia and hydrofluoric acid, and extraction of palladium and platinum as iodides by methylisobutylketone (Terashima, 1991a). Precision and accuracy of this method have been tested by analyzing

Table 4 1991 compiled values for Ag, Au, Pd and Pt in 26 GSJ geochemical reference samples in ppb.

Sample	Ag	Au	Pd	Pt
"Igneous rock series"				
JA-1	33±7(4)	0.2±0.1(6)	<0.2(1)	0.12-2.9(3)
JA-2	43±4(4)	0.3±0.1(4)	0.5(1)	1.3-2.5(2)
JA-3	75±6(4)	1.0-1.14(3)	1.1(1)	1.7-6.9(2)
JB-1	45±4(5)	0.8±0.1(4)	0.7(1)	1.6-6.7(2)
JB-1a	41±2(4)	0.8±0.1(5)	0.6-1.6(2)	1.6-3.8(2)
JB-2	72±2(4)	6.0±1.2(8)	5.6-6.7(3)	4.0-8.4(2)
JB-3	55-60(3)	2.1±0.2(5)	3.3-3.4(2)	4.3-6.2(2)
JF-1	16.5-17(2)	0.1(1)	<0.2(1)	<0.5(1)
JF-2	17-20(2)	0.1(1)	<0.2(1)	<0.5(1)
JG-1	25±1(4)	0.13(3)	<0.2(1)	<0.5(1)
JG-1a	21-24(3)	0.2±0.1(5)	<0.2(1)	<0.5(1)
JG-2	17-20(3)	0.03-0.08(3)	<0.2(1)	<0.5(1)
JG-3	28±4(4)	0.2±0.2(5)	<0.2(1)	<0.5(1)
JGb-1	23-25(3)	1.1±0.1(5)	0.18(1)	<0.5(1)
JP-1	1.5(3)	0.15-0.35(3)	1.2(2)	4.0-5.7(2)
JR-1	31(3)	0.2±0.1(5)	<0.2(1)	<0.5(1)
JR-2	21-23(3)	0.04-0.14(3)	<0.2(1)	<0.5(1)
"Sedimentary rock series"				
JCh-1	4.1(1)	0.13(1)	0.4(1)	<0.5(1)
JDo-1	1.9(1)	0.09(1)	<0.2(1)	<0.5(1)
JLk-1	190-205(2)	4.6-8.2(3)	3.0(1)	1.4(1)
JLs-1	1.3(1)	0.07(1)	<0.2(1)	<0.5(1)
JSd-1	36(1)	0.93(1)	0.5(1)	<0.5(1)
JSd-2	1040(1)	54.6(1)	21.2(1)	16.7(1)
JSd-3	3000-3010(2)	5.66(1)	3.2(1)	1.3(1)
JSl-1	119(1)	0.93(1)	0.8(1)	1.3(1)
JSl-2	61(1)	0.92(1)	1.3(1)	1.5(1)

The number of data available is indicated in parentheses.

Table 5 Comparison of the results for Pd and Pt in ten USGS rock reference samples.

Sample	Pd (ppb)			Pt (ppb)		
	Terashima (1991a)	Aruscavage *et al.* (1984)	Rowe *et al.* (1971)	Terashima (1991a)	Aruscavage *et al.* (1984)	Rowe *et al.* (1971)
AGV-1	<0.2	<0.2	<0.5	1.2±0.2	<1	1.1
BCR-1	<0.2	<0.2	<0.5	0.6±0.2	<1	2.3
BHVO-1	3.2±0.2	2.93±0.39		2.5±0.7	2.2±0.3	
DTS-1	<0.2	<0.2	<0.5	1.7±0.4	1.4, 1.8	1.7
G-2	<0.2	<0.2	<0.5	<0.5	<1	<0.5
GSP-1	<0.2	<0.2	<0.5	<0.5	<1	<0.5
MAG-1	1.9±0.4	0.8, 0.8		1.5±0.6	1.0, 1.0	
PCC-1	5.2±0.6	4.36±0.56	4.7	6.6±0.7	5.7±0.7	5.8
SDC-1	0.6±0.2	0.6, 0.6		0.8±0.2	1.0, 1.2	
SGR-1	5.0±0.8	3.6, 3.9		3.1±0.3	2.3, 3.6	

ten USGS geochemical reference samples. The results are summarized in Table 5, suggesting the good agreement between the results of Terashima (1991a) and other references.

Geologists, geochemists or analytical chemists who are interested in participating in our program are invited to write to Liaison Officer of Reference Samples, Geochemistry Section, Geological Survey of Japan, 1-1-3 Higashi, Tsukuba, 305 Japan.

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Appendix

Table A-1 Individual data for Ag, Au, Pd and Pt (ppb).

Element	Content	Method code	Reference code
JA-1			
Ag	<20	NAA	A-6′
	<20	OES	B-326
	<250	AAS	B-224
	<800	AAS	B-45
	23	AAS	B-279
	34	NAA	B-286
	34	NAA	B-298
	40	AAS	B-427
	500	OES	B-130
Au	0.092	NAA	A-6′
	0.1	AAS	B-268
	0.17		B-146
	0.18	NAA	B-286
	0.18	AAS	B-445
	0.19	NAA	B-298
	0.2	NAA	B-175
Pd	<0.2	AAS	B-335
Pt	0.12	NAA	A-6′
	0.5	AAS	B-335
	2.9	NAA	B-298
JA-2			
Ag	<20	OES	B-326
	<250	AAS	B-224
	38	AAS	B-427
	42	NAA	B-298
	44	NAA	B-286
	47	AAS	B-279
Au	0.14	AAS	B-268
	0.2	AAS	B-414
	0.25	NAA	B-298
	0.25	AAS	B-445
	0.28	NAA	B-286
	0.3	NAA	B-175
Pd	<0.4	AAS	B-414
	0.5	AAS	B-335
Pt	1.3	AAS	B-335
	2.5	NAA	B-298
JA-3			
Ag	<250	AAS	B-224
	71	NAA	B-286
	71	NAA	B-298
	74	AAS	B-427
	84.5	AAS	B-279
	120	OES	B-326
Au	0.54	AAS	B-268
	0.6	AAS	B-414
	1.0	NAA	B-298
	1.05	AAS	B-445
	1.14	NAA	B-286
Pd	0.9	AAS	B-414
	1.1	AAS	B-335
Pt	1.7	AAS	B-335
	6.9	NAA	B-298
	11	NAA	B-286
JB-1			
Ag	<50	OES	C-2
	<200	AAS	B-204
	<250	AAS	B-224
	41.3	IDMS	M-9′, 12′
	41.4	IDMS	M-13′
	44	AAS	B-427
	45	NAA	A-6′
	51	AAS	T-18′
	72	AAS	B-366
	400	AAS	G-1′
	2400	NAA	B-7
Au	<4.8	INAA	B-322
	0.04		B-146
	0.65	AAS	B-268
	0.77	NAA	C-2′
	0.85	NAA	A-6′
	0.85	NAA	B-166
	0.85	NAA	B-445
Pd	0.7	AAS	B-335
Pt	1.6	AAS	B-335
	6.7	NAA	A-6′
JB-1a			
Ag	<250	AAS	B-224
	<500	AAS	B-103
	38	AAS	B-427
	40	NAA	B-298
	42	NAA	B-286
	43	AAS	B-279
	110	OES	B-326
Au	0.4	AAS	B-414
	0.66	NAA	B-286
	0.66	NAA	B-298
	0.71	AAS	B-268
	0.8	NAA	B-175
	0.86	AAS	B-445
	0.9	NAA	B-166

Table A-1 Continued

Element	Content	Method code	Reference code
Pd	<0.4	AAS	B-414
	0.6	AAS	B-335
	1.59	NAA	B-298
Pt	1.6	AAS	B-335
	3.8	NAA	B-298
	16	NAA	B-286
JB-2			
Ag	≦40	NAA	A-6′
	<250	AAS	B-224
	<800	AAS	B-45
	71	NAA	B-286
	71	NAA	B-298
	72	AAS	B-427
	74.5	AAS	B-279
	130	OES	B-326
	500	OES	B-130
Au	0.73		B-146
	3.5	INAA	B-322
	3.7	AAS	B-414
	4.56	AAS	B-268
	5.36	AAS	B-445
	5.8	NAA	B-298
	6.3	NAA	B-166
	6.31	NAA	B-286
	6.4	NAA	B-175
	7.2	NAA	A-6′
	7.3	NAA	B-323
Pd	5.6	AAS	B-414
	6.6	AAS	B-335
	6.7	NAA	B-298
Pt	<20	NAA	A-6′
	4.0	AAS	B-335
	8.4	NAA	B-298
	40	NAA	B-286
JB-3			
Ag	<250	AAS	B-224
	<800	AAS	B-45
	55	AAS	B-427
	59	NAA	B-286
	60	NAA	B-298
	100	OES	B-326
	103	AAS	B-279
	500	OES	B-130
Au	0.22		B-146
	1.6	AAS	B-414
	1.9	NAA	B-298
	1.91	AAS	B-268
	2.0	NAA	B-175
	2.06	AAS	B-445
	2.1	NAA	B-166
	2.36	NAA	B-286
Pd	2.8	AAS	B-414
	3.3	AAS	B-335
	3.39	NAA	B-298
Pt	4.3	AAS	B-335
	6.2	NAA	B-298
	50	NAA	B-286
JF-1			
Ag	<250	AAS	B-224
	16.5	AAS	B-279
	17	AAS	B-427
	70	OES	B-326
Au	<0.2	AAS	B-414
	0.04	AAS	B-268
	0.11	AAS	B-445
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
JF-2			
Ag	<250	AAS	B-224
	17	AAS	B-279
	20	AAS	B-427
	60	OES	B-326
Au	<0.2	AAS	B-414
	0.06	AAS	B-268
	0.12	AAS	B-445
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
JG-1			
Ag	<50	OES	C-2
	<200	AAS	B-204
	<250	AAS	B-224
	<800	NAA	B-7
	24	NAA	A-6′
	25.4	IDMS	M-9′, 12′
	26	AAS	B-427
	26.1	IDMS	M-13′
	42	AAS	T-18′
	62	AAS	B-366
	73	OES	C-1′
Au	0.064		B-146
	0.12	AAS	B-268
	0.13	NAA	A-6′
	0.13	NAA	B-166
	0.13	AAS	B-445
Pd	<0.2	AAS	B-335

Table A-1 Continued

Element	Content	Method code	Reference code
Pt	<0.5	AAS	B-335
	4.8	NAA	A-6′
JG-1a			
Ag	<250	AAS	B-224
	<500	AAS	B-103
	21	AAS	B-427
	23	NAA	B-286
	24	NAA	B-298
	53.5	AAS	B-279
	66	OES	B-326
Au	<0.2	AAS	B-414
	0.12	AAS	B-268
	0.14	NAA	B-298
	0.15	AAS	B-445
	0.17	NAA	B-286
	0.3	NAA	B-175
	0.4	NAA	B-166
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
	≦15	NAA	B-298
	12	NAA	B-286
JG-2			
Ag	<250	AAS	B-224
	17	AAS	B-427
	19	NAA	B-286
	20	NAA	B-298
	43	AAS	B-279
	70	OES	B-326
Au	<0.2	AAS	B-414
	0.034	NAA	B-298
	0.04	NAA	B-286
	0.08	AAS	B-268
	0.08	AAS	B-445
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
	≦6	NAA	B-298
JG-3			
Ag	<250	AAS	B-224
	25	AAS	B-427
	26	NAA	B-286
	28	NAA	B-298
	34.5	AAS	B-279
	64	OES	B-326
Au	<0.2	AAS	B-414
	0.04	NAA	B-286
	0.05	NAA	B-298
	0.08	AAS	B-268
	0.17	AAS	B-445
	0.3	NAA	B-175
	0.4	NAA	B-166
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
	≦7	NAA	B-298
JGb-1			
Ag	<250	AAS	B-224
	<800	AAS	B-45
	23	NAA	B-286
	23	NAA	B-298
	25	AAS	B-427
	70	OES	B-326
	75	AAS	B-279
	500	OES	B-130
Au	0.38		B-146
	0.73	AAS	B-268
	0.9	AAS	B-414
	1.0	NAA	B-175
	1.06	AAS	B-445
	1.1	NAA	B-166
	1.15	NAA	B-298
	1.19	NAA	B-286
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
	0.18	NAA	B-298
Pt	≦20	NAA	B-298
	<0.5	AAS	B-335
	18	NAA	B-286
JP-1			
Ag	<20	OES	B-326
	1.5	NAA	B-286
	1.5	NAA	B-298
	1.5	AAS	B-427
	19.5	AAS	B-279
Au	0.09	AAS	B-268
	0.15	NAA	B-286
	0.20	NAA	B-298
	0.2	AAS	B-414
	0.35	AAS	B-445
Pd	1.2	NAA	B-298
	1.2	AAS	B-335
	1.4	AAS	B-414
Pt	4.0	AAS	B-335
	5.7	NAA	B-298

Table A-1 Continued

Element	Content	Method code	Reference code
JR-1			
Ag	<250	AAS	B-224
	<800	AAS	B-45
	31	NAA	B-286
	31	NAA	B-298
	31	AAS	B-427
	76	OES	B-326
	79.5	AAS	B-279
	500	OES	B-130
Au	0.05	AAS	B-268
	0.14	NAA	B-286
	0.16	NAA	B-298
	0.18	AAS	B-445
	0.2	AAS	B-414
	0.4	NAA	B-166
	0.4	NAA	B-175
	0.61		B-146
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
	≦15	NAA	B-298
JR-2			
Ag	<250	AAS	B-224
	21	AAS	B-427
	22	NAA	B-286
	23	NAA	B-298
	44.5	AAS	B-279
	72	OES	B-326
	100	AAS	B-45
	500	OES	B-130
Au	0.04	NAA	B-286
	0.05	AAS	B-268
	0.056	NAA	B-298
	0.14	AAS	B-445
	0.2	AAS	B-414
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
	≦16	NAA	B-298
JCh-1			
Ag	4.1	AAS	B-427
Au	<0.2	AAS	B-414
	0.13	AAS	B-445
Pd	0.4	AAS	B-335
	0.5	AAS	B-414
Pt	<0.5	AAS	B-335
JDo-1			
Ag	<100	AAS	B-266
	1.9	AAS	B-427
Au	<0.2	AAS	B-414
	0.04	AAS	B-268
	0.09	AAS	B-445
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
JLk-1			
Ag	190	AAS	B-266
	205	AAS	B-427
Au	0.5	AAS	B-414
	3.6	AAS	B-268
	4.59	AAS	B-445
	5.3	INAA	B-308
	8.2	INAA	B-229-2
Pd	1.1	AAS	B-414
	3.0	AAS	B-335
Pt	1.4	AAS	B-335
JLs-1			
Ag	<100	AAS	B-266
	1.3	AAS	B-427
Au	<0.2	AAS	B-414
	0.03	AAS	B-268
	0.07	AAS	B-445
Pd	<0.2	AAS	B-335
	<0.4	AAS	B-414
Pt	<0.5	AAS	B-335
JSd-1			
Ag	36	AAS	B-427
	2500	AAS	B-338
Au	0.7	AAS	B-414
	0.93	AAS	B-445
Pd	<0.4	AAS	B-414
	0.5	AAS	B-335
Pt	<0.5	AAS	B-335
JSd-2			
Ag	1040	AAS	B-427
	3500	AAS	B-338
Au	54.6	AAS	B-445
Pd	21.2	AAS	B-335
Pt	16.7	AAS	B-335
JSd-3			
Ag	1000	ICP	B-334
	3000	OES	B-402-1
	3010	AAS	B-427
	4000	AAS	B-338

Table A-1 Continued

Element	Content	Method code	Reference code	Element	Content	Method code	Reference code
Au	2.9	AAS	B-414		0.8	AAS	B-335
	5.66	AAS	B-445	Pt	1.3	AAS	B-335
Pd	0.9	AAS	B-414				
	3.2	AAS	B-335	JSl-2			
Pt	1.3	AAS	B-335	Ag	61	AAS	B-427
					2500	AAS	B-338
JSl-1				Au	<0.2	AAS	B-414
Ag	119	AAS	B-427		0.92	AAS	B-445
	2500	AAS	B-338	Pd	0.5	AAS	B-414
Au	0.3	AAS	B-414		1.3	AAS	B-335
	0.93	AAS	B-445	Pt	1.5	AAS	B-335
Pd	0.7	AAS	B-414				

Table A-2 Code for analytical methods.

Code	Method
AAS	Atomic absorption spectrometry
ICP	Inductively coupled plasma optical emission spectrometry
IDMS	Isotope dilution mass spectrometry
INAA	Instrumental neutron activation analysis
NAA	Neutron activation analysis
OES	Optical emission spectrometry

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地質調査所（GSJ）作製の岩石標準試料中の銀，金，パラジウム，白金の含有量（1991）

寺島　滋・伊藤司郎・安藤　厚

要　旨

地質調査所作製の岩石標準試料26種について，1991年6月迄に報告を受けた銀，金，パラジウム，白金の分析値（総数373）をもとに，1991年値を算出した．

貴金属の日常分析における試料の前処理法としては，王水のみによる分解が広く用いられているが，この方法は王水とフッ化水素酸を併用する方法に比べて明らかに低値を与える場合が多く，また，原子吸光分析法による測定で共存成分の分離を行わず，しかもバックグラウンド吸収を補正しない場合は顕著な高値を与えるので，これらの結果は統計処理から除外した．

利用できる分析値が4個以上ある場合は平均値と標準偏差を算出し，それ以下の場合は範囲又は個々の値を1991年値とした．銀，金についてはいくつかの試料で分析値の良好な一致が認められたが，パラジウム，白金についての報告値は少なく，推せん値等の設定のためにはさらに多くのデータが必要である．

（受付：1991年7月17日；受理：1991年8月12日）