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## Appendix A

### Summary of SARM 1 to 6 sales from 1982 to 1999

<b>Financial year</b>	<b>SARMs 1-6 units sold</b>	<b>SARMs 1-6 Sales (R)</b>	<b>Total SARMs Sales (R)</b>
1982/1983	274	14 457	28 388
1983/1984	292	17 254	31 111
1984/1985	197	14 629	30 255
1985/1986	155	17 753	49 694
1986/1987	315	30 990	74 165
1987/1988	453	44 799	104 121
1988/1989	258	35 910	117 278
1989/1990	266	42 460	123 989
1990/1991	142	24 769	120 751
1991/1992	165	30 268	125 396
1992/1993	152	28 390	122 099
1993/1994	137	42 509	180 874
1994/1995	130	45 645	230 396
1995/1996	161	62 135	300 157
1996/1997	131	63 802	397 763
1997/1998	163	83 209	436 911
1998/1999	91	65 211	472 934
<b>TOTAL</b>	<b>3 482</b>	<b>664 190</b>	<b>2 946 282</b>

# Appendix B

## Compilation of SARM 2

**Table 1:** Summary of the published data for SiO<sub>2</sub> in SARM 2

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
63.8	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
63.6	not reported	ICP-AES	Walsh 1980[39]
63.61	0.15	WD-XRF	Stork <i>et al.</i> 1987[40]
64.61	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
63.22	not reported	XRF	Couture <i>et al.</i> 1993[42]
63.6*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
63.61 (n=6) 0.15 0.30 0.5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
63.63 (n=65)	1.08	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 2:** Summary of the published data for Al<sub>2</sub>O<sub>3</sub> in SARM 2

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
17.2	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
16.61	not reported	ICP-AES	Walsh 1980[39]
17.42*	0.63	ICP-AES	Church 1981[44]
17.11	0.05	WD-XRF	Stork <i>et al.</i> 1987[40]
17.62	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
17.15	not reported	XRF	Couture <i>et al.</i> 1993[42]
17*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
17.15 (n=7) 0.22 0.44 2.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
17.34 (n=69)	0.46	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 3:** Summary of the published data for total Fe as Fe<sub>2</sub>O<sub>3</sub> in SARM 2

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
1.39	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
1.37	not reported	ICP-AES	Walsh 1980[39]
1.49*	0.03	ICP-AES	Church 1981[44]
1.42	0.03	WD-XRF	Stork <i>et al.</i> 1987[40]
1.4	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
1.37	not reported	XRF	Couture <i>et al.</i> 1993[42]
1.45*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
1.40 (n=7) 0.04 0.08 5.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
1.40 (n=69)	0.2	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 4:** Summary of the published data for MgO in SARM 2

<b>Published values</b>	<b>Standard deviation</b>	<b>Analysis technique</b>	<b>Reference</b>
<b>(% oxide)</b>	<b>(% oxide)</b>		
0.47	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.43	not reported	ICP-AES	Walsh 1980[39]
0.47	0.02	ICP-AES	Church 1981[44]
0.48	0.02	WD-XRF	Stork <i>et al.</i> 1987[40]
0.57	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.43	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.46	not reported	ICP-AES	Cantagrel and Pin 1994[43]
0.47 (n=7)		Median	
0.02		MADe	
0.04		Expanded uncertainty, k=2	
8.5		Relative expanded uncertainty, %	
0.46 (n=58)	0.19	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 5:** Summary of the published data for CaO in SARM 2

<b>Published values</b>	<b>Standard deviation</b>	<b>Analysis technique</b>	<b>Reference</b>
<b>(% oxide)</b>	<b>(% oxide)</b>		
3.05	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
3.15*	0.1	ICP-AES	Church 1981[44]
3.14	0.02	WD-XRF	Stork <i>et al.</i> 1987[40]
3.09	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
3.21*	0.01	ICP-AES	Cantagrel and Pin 1994[43]
2.94	not reported	INAA	Korotev 1996[45]
3.12 (n=6)		Median	
0.07		MADe	
0.14		Expanded uncertainty, k=2	
4.5		Relative expanded uncertainty, %	
3.22 (n=72)	0.27	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 6:** Summary of the published data for Na<sub>2</sub>O in SARM 2

<b>Published values</b> <b>(% oxide)</b>	<b>Standard deviation</b> <b>(% oxide)</b>	<b>Analysis technique</b>	<b>Reference</b>
0.4	not reported	ICP-AES	Walsh 1980[39]
0.433*	0.02	ICP-AES	Church 1981[44]
0.54	0.03	WD-XRF	Stork <i>et al.</i> 1987[40]
0.3	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.4	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.42*	0.003	ICP-AES	Cantagrel and Pin 1994[42]
0.41 (n=6) 0.03 0.06 14.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.43 (n=50)	0.11	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 7:** Summary of the published data for K<sub>2</sub>O in SARM 2

<b>Published values</b> <b>(% oxide)</b>	<b>Standard deviation</b> <b>(% oxide)</b>	<b>Analysis technique</b>	<b>Reference</b>
14.74	not reported	ICP-AES	Walsh 1980[39]
>10*	not reported	ICP-AES	Church 1981[44]
15.18	0.18	WD-XRF	Stork <i>et al.</i> 1987[40]
15.28	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
15.28	not reported	XRF	Couture <i>et al.</i> 1993[42]
15.4*	0.12	ICP-AES	Cantagrel and Pin 1994[43]
15.28 (n=5) 0.15 0.30 2.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
15.35 (n=65)	0.92	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution



**Table 8:** Summary of the published data for TiO<sub>2</sub> in SARM 2

<b>Published values</b>	<b>Standard deviation</b>	<b>Analysis technique</b>	<b>Reference</b>
<b>(% oxide)</b>	<b>(% oxide)</b>		
0.04	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.04	not reported	ICP-AES	Walsh 1980[39]
0.041*	0.001	ICP-AES	Church 1981[44]
0.04	0.01	WD-XRF	Stork <i>et al.</i> 1987[40]
0.06	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.04	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.04*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
0.04 (n=7)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 9:** Summary of the published data for MnO in SARM 2

<b>Published values</b>	<b>Standard deviation</b>	<b>Analysis technique</b>	<b>Reference</b>
<b>(% oxide)</b>	<b>(% oxide)</b>		
0.01	0.001	WD-XRF	Stork <i>et al.</i> 1987[40]
0.01	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.01	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.01*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 10:** Summary of the published data for P<sub>2</sub>O<sub>5</sub> in SARM 2

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
0.118	not reported	Spectrophotometric	Watkins 1979[46]
0.11	not reported	ICP-AES	Walsh 1980[39]
0.012*	0.001	ICP-AES	Church 1981[44]
0.12	0.003	WD-XRF	Stork <i>et al.</i> 1987[40]
0.12	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.15	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.071	not reported	ICP-AES	Cantagrel and Pin 1994[43]
0.076	0.004	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.11 (n=8) 0.03 0.06 54.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.12 (n=38)	0.03	Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 11:** Summary of the published data for Ag in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<2*	not reported	ICP-AES	Church 1981[44] Jarvis and Williams 1989[47]
0.1*	not reported	SN-ICP-MS	1989[47]
<1 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.083		Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

<sup>#</sup> Primary method

**Table 12:** Summary of the published data for As in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<6*	not reported	ICP-AES	Church 1981[44]
0.25	not reported	FAAS, Hydride generation	Terashima 1986[48] Jarvis and Williams 1989[47]
<DL*	not reported	SN-ICP-MS	1989[47]
0.26	not reported	INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <i>et al.</i> 1978[7]
0.21			

\* Incomplete dissolution

DL =detection limit

**Table 13:** Summary of the published data for Au in SARM 2

Published values ( $\text{ng}\cdot\text{g}^{-1}$ )	Standard deviation ( $\text{ng}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<3000*	not reported	ICP-AES	Church 1981[44]
0.29	0.02	Flameless AAS (GTA)	Terashima 1988[49]
<2000 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.062	not reported	ICP-MS	Plessen and Erzinger 1998[50]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

<sup>#</sup> Primary method

**Table 14:** Summary of the published data for B in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
8.8*	not reported	ICP-AES	Walsh 1985[51]
15.4*	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
8.9-14.0 (n=7)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 15:** Summary of the published data for Ba in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2600	not reported	Grimm glow discharge lamp	Bubert and Hagenah 1981[52]
2615*	52	ICP-AES	Church 1981[44]
2804	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
734	not reported	ICP-AES	Cantagrel and Pin 1994[43]
730	34	IE-ICP-AES	Cantagrel and Pin 1994[43]
2530 <sup>#</sup>	76	INAA	Korotev 1996[45]
2565 (n=6) 214 428 16.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
2400 (n=29) 2585	360 38	Originally certified value ID-ICP-MS	Steele <i>et al.</i> 1978[7] Botha <i>et al.</i> 2007[53]

\* Incomplete dissolution

<sup>#</sup> Primary method

**Table 16:** Summary of the published data for Be in SARM 2

Published values ( $\mu\text{g.g}^{-1}$ )	Standard deviation ( $\mu\text{g.g}^{-1}$ )	Analysis technique	Reference
1.61*	0.03	ICP-AES	Church 1981[44]
2.1*	0.36	SE-Flameless AAS	Vilcsek and Lohmann 1982[54]
1.48	not reported	ICP-AES	Watkins and Thompson[55] 1983
1.62	not reported	ICP-AES	Watkins and Thompson 1983[55]
1.66*	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
1.62 (n=5) 0.06 0.12 7.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
1.099-2.0 (n=11)		Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 17:** Summary of the published data for Bi in SARM 2

Published values ( $\text{ng.g}^{-1}$ )	Standard deviation ( $\text{ng.g}^{-1}$ )	Analysis technique	Reference
39	not reported	Flameless AAS	Heinrichs 1979[56]
<2500*	not reported	ICP-AES	Church 1981[44]
17	not reported	Flameless AAS (hydride generation)	Terashima 1984[57]
500*	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
400		Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution



**Table 18:** Summary of the published data for Cd in SARM 2

Published values (ng.g <sup>-1</sup> )	Standard deviation (ng.g <sup>-1</sup> )	Analysis technique	Reference
43	not reported	Flameless AAS	Heinrichs 1979[56]
16	82	ID-MS	Rosman and De Laeter 1980[58]
<2000*	not reported	ICP-AES	Church 1981[44]
690*	not reported	ICP-MS	Jarvis and Williams 1989[47]
Not analysed <sup>#</sup>	not reported	INAA	Korotev 1996[45]
1000-35000 (n=6)	0.002	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification ID-ICP-MS	Steele <u>et al.</u> 1978[7] Botha <u>et al.</u> 2007[53]

\* Incomplete dissolution

∞ Primary method

**Table 19:** Summary of the published data for Ce in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
16	2	Candoluminescence ES	Mazzucotelli and Vannucci 1980[59]
20*	4	ICP-AES	Church 1981[44]
11.5 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<35	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
ND	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
10.7	0.5	IE-ICP-AES	Jarvis and Jarvis 1988[62]
12.2	0.1	IE-ICP-AES	Roelandts 1990[63]
11	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
9.5	0.9	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
12	2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
62.35	not reported	ICP-AES	Cantagrel and Pin 1994[43]
63.6	3.9	IE-ICP-AES	Cantagrel and Pin 1994[43]
11.9	0.2	IE-ICP-AES	Cantagrel and Pin 1994[43]
11.7 <sup>#</sup>	0.3	INAA	Korotev 1996[45]
11.5	0.2	IE-ICP-AES	Rucandio 1997[66]
11.9 (n=13)		Median	
1.3		MADe	
2.6		Expanded uncertainty, k=2	
21.8		Relative expanded uncertainty, %	
11 (n=9)	2	Provisional value	Steele <i>et al.</i> 1978[7]
11.9 (9.6-14.4) <sup>#</sup> (n=14)	2.4	Revised value	Hansen and Ring 1985[9]

\* Incomplete dissolution

∞ Primary method

# 95 % confidence interval

**Table 20:** Summary of the published data for Co in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2.5*	1	ICP-AES	Church 1981[44]
2.8 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60] Anderson and Victor 1986[67]
2.97	0.03	IE-FAAS	Victor 1986[68]
2.95	0.01	IE-FAAS	Korotev 1996[45]
2.87 <sup>#</sup>	0.08	INAA	
2.87 (n=5) 0.12 0.24 8.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
3 (n=22)	2	Provisional value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

<sup>#</sup> Primary method**Table 21:** Summary of the published data for Cr in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
12.7*	1	ICP-AES	Church 1981[44] Jarvis and Williams 1989[47]
5.52*	not reported	SN-ICP-MS	Stork <i>et al.</i> 1987[40]
ND	not reported	WD-XRF	Cantagrel and Pin 1994[43]
123.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
134	15	IE-ICP-AES	Korotev 1996[45]
12.5	0.4	INAA	
12 (n=29)	4	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

ND not detected

**Table 22:** Summary of the published data for Cs in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
6.33	0.05	Flame emission	Goguel 1981[69]
6.68	not reported	Flame emission	Terashima and Mita 1981[70]
6.47 <sup>#</sup>	0.19	INAA	Korotev 1996[45]
6.47 (n=3) 0.21 0.42 6.5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
5.7-10.14 (n=10)		Range reported during certification	Steele <u>et al.</u> 1978[7]

<sup>#</sup> Primary method

**Table 23:** Summary of the literature data for Cu in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
18.4*	1	ICP-AES	Church 1981[44]
20.51	0.07	IE-AAS	Victor 1983[71]
20	not reported	ED-XRF	Webb <u>et al.</u> 1990[72]
53.15	not reported	ICP-AES	Cantagrel and Pin 1994[43]
51.7	2.0	IE-ICP-AES	Cantagrel and Pin 1994[43]
20.5 (n=5) 3.1 6.2 30.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
19 (n=29)	5	Originally certified value	Steele <u>et al.</u> 1978[7]
17.1	0.4	ID-ICP-MS	Botha <u>et al.</u> 2007[53]

\* Incomplete dissolution

**Table 24:** Summary of the published data for Dy in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.45 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<4	not reported	IE-CP-AES	Bolton <i>et al.</i> 1983[61]
0.33	0.02	IE-CP-AES	Jarvis and Jarvis 1988[62]
0.48	0.01	IE-CP-AES	Roelandts 1990[63] Watkins and Nolan
0.3	not reported	IE-CP-AES	1990[64]
0.37	0.03	IE-CP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.4	0.1	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.3	0.01	IE-CP-AES	Cantagrel and Pin 1994[43]
0.39 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.32	not reported	IE-CP-AES	Rucandio 1997[66]
0.37 (n=9) 0.07 0.14 37.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.3-0.63 (n=3)		Range reported during certification	Steele <i>et al.</i> 1978[7]

<sup>#</sup> Primary method

**Table 25:** Summary of the published data for Er in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.13 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.12	0.02	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.12	0.02	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.41	0.14	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.12 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.074	0.07	IE-ICP-AES	Rucandio 1997[66]
0.12 (n=6) 0.01 0.02 16.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.068		Reported during certification	Steele <i>et al.</i> 1978[7]

<sup>#</sup> Primary method



**Table 26:** Summary of the published data for Eu in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<0.6*	not reported	ICP-AES	Church 1981[44]
0.27 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
1.3	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
0.27	0.01	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.28	0.01	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
0.24	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.24	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.5	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.26	0.01	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.259 <sup>#</sup>	0.008	INAA	Korotev 1996[45]
0.28	0.01	IE-ICP-AES	Rucandio 1997[66]
0.27 (n=10) 0.02 0.04 14.8  0.30 (0.27-0.38) <sup>#</sup> (n=14)	0.06	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Revised value	Hansen and Ring 1985[9]

\* Incomplete dissolution

∞ Primary method

# 95 % confidence interval

**Table 27:** Summary of the published data for F in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
76	2	Ion selective electrode	Troll and Farzenah 1978[73]
135.5 <sup>#</sup>	8.1	INAA	Esprit <i>et al.</i> 1984[74]
146	not reported	PIGE	Roelandts <i>et al.</i> 1985[75]
86-370 (n=10)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

∞ Primary method

**Table 28:** Summary of the published data for Ga in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
11.3	0.2	IE-FAAS	Van der Walt and Strelow 1984[76]
10	not reported	ED-XRF	Webb et al. 1990[72]
11 (n=12)	4	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele et al. 1978[7]

**Table 29:** Summary of the published data for Gd in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<2*	not reported	ICP-AES	Church 1981[44]
0.79 <sup>#</sup>	not reported	INAA	Potts et al. 1981[60]
6	not reported	IE-ICP-AES	Bolton et al. 1983[61]
0.83	0.08	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.87	0.01	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
0.72	not reported	IE-ICP-AES	Bauer-Wolf et al. 1993[65]
0.87	0.1	IE-ICP-AES	Bauer-Wolf et al. 1993[65]
0.9	0.3	IE-XRF	Bauer-Wolf et al. 1993[65]
0.79	0.03	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.75 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.75	0.02	IE-ICP-AES	Rucandio 1997[66]
0.81 (n=10) 0.09 0.18 22.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele et al. 1978[7]
0.56-0.59 (n=3)			

\* Incomplete dissolution

<sup>#</sup> Primary method

**Table 30:** Summary of the published data for Hf in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.46 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.3	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
0.466 <sup>#</sup>	0.01	INAA	Korotev 1996[45]
0.46 (n=3) 0.01 0.02 4.3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.2-41 (n=5)		Range reported during certification	Steele <i>et al.</i> 1978[7]

<sup>#</sup> Primary method

**Table 31:** Summary of the published data for Hg in SARM 2

Published values ( $\text{ng}\cdot\text{g}^{-1}$ )	Standard deviation ( $\text{ng}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
26.1	1.9	Flameless AAS	Flanagan <i>et al.</i> 1982[77]
9.4	0.4	Flameless AAS (Hydride generation)	Chan and Bina 1989[78]
35	3	Cold vapor AAS	Terashima 1994[79]
Not analysed <sup>#</sup>		INAA	Korotev 1996[45]
<10		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
		Reported during certification	Steele <i>et al.</i> 1978[7]

<sup>#</sup> Primary method

**Table 32:** Summary of the published data for Ho in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.07 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.05	0.02	IE-ICP-AES	Jarvis and Jarvis 1988[62] Watkins and Nolan 1990[64]
ND	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.25	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.059 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.05	0.01	IE-ICP-AES	Rucandio 1997[66]
0.055 (n=4) 0.005 0.010 18.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.048		Reported during certification	Steele <i>et al.</i> 1978[7]

<sup>∞</sup> Primary method

ND not detected

**Table 33:** Summary of the published data for Ir in SARM 2

Published values ( $\text{ng}\cdot\text{g}^{-1}$ )	Standard deviation ( $\text{ng}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2500	not reported	ETV-ICP-MS	Sen Gupta and Gregoire 1989[80]
2000	not reported	SN-ICP-MS	Sen Gupta and Gregoire 1989[80]
Not analysed <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.01	not reported	ICP-MS	Plessen and Erzinger 1998[50]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
		Reported during certification	Steele <i>et al.</i> 1978[7]

<sup>∞</sup> Primary method

**Table 34:** Summary of the published data for La in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
6*	1	ICP-AES	Church 1981[44]
5.1 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
13	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
7	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
4.47	0.15	IE-ICP-AES	Jarvis and Jarvis 1988[62]
5.4	0.1	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
4.9	not reported	IE-ICP-AES	
5.5	0.3	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
5.8	0.4	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
33.25	not reported	ICP-AES	Cantagrel and Pin 1994[43]
34.8	0.8	IE-ICP-AES	Cantagrel and Pin 1994[43]
5.69	0.4	IE-ICP-AES	Cantagrel and Pin 1994[43]
4.95 <sup>#</sup>	0.1	INAA	Korotev 1996[45]
4.79	0.03	IE-ICP-AES	Rucandio 1997[66]
5.60 (n=14) 0.99 1.98 35.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
5 (n=9)	1.3	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

<sup>#</sup> Primary method



**Table 35:** Summary of the published data for Li in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2	not reported	Grimm glow discharge lamp	Bubert and Hagenah 1981[52]
<2*	not reported	ICP-AES	Church 1981[44]
1.38-4.0 (n=11)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 36:** Summary of the published data for Lu in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.006 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.01	not reported	IE-ICP-AES	Jarvis and Jarvis 1988[62]
<0.05	not reported	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
ND	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.01	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
ND	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.011 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
0.016	0.003	IE-ICP-AES	Rucandio 1997[66]
0.010 (n=5) 0.001 0.002 38.3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during revision	Hansen and Ring 1985[9]
0.006-0.3 (n=6)			

**Table 37:** Summary of the published data for Mo in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.76	not reported	Spectrophotometry	Terashima 1980[81]
<3*	not reported	ICP-AES	Church 1981[44]
<DL	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.29-10 (n=13)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.83	0.04	Range reported during certification ID-ICP-MS	Steele <i>et al.</i> 1978[7] Botha <i>et al.</i> 2007[53]

\* Incomplete dissolution

**Table 38:** Summary of the published data for Nb in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
4.5	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
1.3	2	WD-XRF	Stork <i>et al.</i> 1987[40]
0.46	not reported	ICP-MS	Jarvis and Williams 1989[47]
2	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
0.25	not reported	ICP-MS	Poitrasson <i>et al.</i> 1993[83]
3.0-5.0 (n=12)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 39:** Summary of the published data for Nd in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<20*	not reported	ICP-AES	Church 1981[44]
6.5 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<30	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
ND	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
6.16	0.09	IE-ICP-AES	Jarvis and Jarvis 1988[62]
6.7	0.1	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
6.3	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
6.3	1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
5.4	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
6.26	0.01	IE-ICP-AES	Cantagrel and Pin[43]
6.6 <sup>#</sup>	0.2	INAA	Korotev 1996[45]
5.92	0.08	IE-ICP-AES	Rucandio 1997[66]
6.3 (n=9)		Median	
0.4		MADe	
0.8		Expanded uncertainty, k=2	
12.7		Relative expanded uncertainty, %	
6 (n=6)	0.43	Provisional value	Hansen and Ring 1985[9]

\* Incomplete dissolution

<sup>#</sup> Primary method

ND not detected

**Table 40:** Summary of the published data for Ni in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
ND	not reported	XRF	Vié le Sage <i>et al.</i> 1979[82]
6*	1	ICP-AES	Church 1981[44]
5	1	XRF	Stork <i>et al.</i> 1987[40]
6.42	0.13	IE-FAAS	Victor 1987[84]
ND	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
116	not reported	ICP-AES	Cantagrel and Pin 1994[43]
112	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
<20 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
7 (n=24)	4	Provisional value	Steele <i>et al.</i> 1978[7]
2.51	0.13	ID-ICP-MS	Botha <i>et al.</i> 2007[53]

ND not detected

\* Incomplete dissolution

<sup>∞</sup> Primary method

**Table 41:** Summary of the published data for Pb in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2.39	0.05	IE-AAS	Victor and Strelow 1980[85]
<13	not reported	ICP-AES	Church 1981[44]
<2	not reported	XRF	Stork <i>et al.</i> 1987[40]
4	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
5 (n=18)	4	Provisional value	Steele <i>et al.</i> 1978[7]
1.83	0.04	ID-ICP-MS	Botha <i>et al.</i> 2007[53]

<sup>\*</sup> Incomplete dissolution

**Table 42:** Summary of the published data for Pd in SARM 2

Published values (ng.g <sup>-1</sup> )	Standard deviation (ng.g <sup>-1</sup> )	Analysis technique	Reference
6	not reported	GF-AAS	Sen Gupta and Gregoire 1989[80]
0.067	not reported	ICP-MS	Plessen and Erzinger 1998[50]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
		Originally certified value	Steele et al. 1978[7]

\* Incomplete dissolution

**Table 43:** Summary of the published data for Pr in SARM 2

Published values (µg.g <sup>-1</sup> )	Standard deviation (µg.g <sup>-1</sup> )	Analysis technique	Reference
1.5 <sup>#</sup>	not reported	INAA	Potts et al. 1981[60]
<15	not reported	WD-XRF	Robinson and Bennett 1981[86]
1.39	0.04	ICP-AES	Jarvis and Jarvis 1988[62]
1.19	not reported	ICP-AES	Watkins and Nolan 1990[64]
1.7	0.3	ICP-AES	Bauer-Wolf et al. 1993[65]
1.5	0.3	IE-XRF	Bauer-Wolf et al. 1993[65]
1.27	0.15	ICP-AES	Cantagrel and Pin 1994[43]
1.5 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
1.25	0.06	ICP-AES	Rucandio 1997[66]
1.45 (n=8) 0.17 0.34 23.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
1		Reported during certification	Steele et al. 1978[7]

<sup>∞</sup> Primary method

**Table 44:** Summary of the published data for Rb in SARM 2

Published values ( $\mu\text{g.g}^{-1}$ )	Standard deviation ( $\mu\text{g.g}^{-1}$ )	Analysis technique	Reference
298	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
680	not reported	Grimm glow discharge lamp	Bubert and Hagenah 1981[52]
543	not reported	WD-XRF	Robinson and Bennett 1981[86]
531	4	WD-XRF	Stork <i>et al.</i> 1987[40]
546	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
528 <sup>#</sup>	15	INAA	Korotev 1996[45]
537 (n=6)		Median	
13		MADe	
26		Expanded uncertainty, k=2	
4.8		Relative expanded uncertainty, %	
530 (n=23)	58	Originally certified value	Steele <i>et al.</i> 1978[7]

<sup>#</sup> Primary method

**Table 45:** Summary of the published data for Ru in SARM 2

Published values ( $\text{ng.g}^{-1}$ )	Standard deviation ( $\text{ng.g}^{-1}$ )	Analysis technique	Reference
3000	not reported	ETV-ICP-MS	Sen Gupta and Gregoire 1989[80]
2600	not reported	SN-ICP-MS	Sen Gupta and Gregoire 1989[80]
2600	not reported	GF-AAS	Sen Gupta and Gregoire 1989[80]
<0.3	not reported	ICP-MS	Plessen and Erzinger 1998[50]
		Median	
		MADe	
		Expanded uncertainty, k=2	
		Relative expanded uncertainty, %	
		Originally certified value	Steele <i>et al.</i> 1978[7]

**Table 46:** Summary of the published data for Sb in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<18*	not reported	ICP-AES	Church 1981[44]
<DL*	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.05	not reported	FAAS, Hydride generation	Terashima 1986[48]
0.05 <sup>#</sup>	0.02	INAA	Korotev 1996[45]
0.17-0.7 (n=7)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

DL detection limit

<sup>∞</sup> Primary method**Table 47:** Summary of the published data for Sc in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
6	not reported	IE-ICP-AES	Bolton <u>et al.</u> 1983[61]
3.6	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
13	not reported	ICP-AES	Cantagrel and Pin 1994[43]
13.5	1.3	IE-ICP-AES	Cantagrel and Pin 1994[43]
3.78 <sup>#</sup>	0.11	INAA	Korotev 1996[45]
3.0-8.0 (n=13)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <u>et al.</u> 1978[7]

<sup>∞</sup> Primary method



**Table 48:** Summary of the published data for Sm in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<5*	not reported	ICP-AES	Church 1981[44]
1.36 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
<10	not reported	WD-XRF	
<15	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
1.14	0.01	IE-ICP-AES	Jarvis and Jarvis 1988[62]
1.14	0.01	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
1.18	not reported	IE-ICP-AES	
1.5	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
1.4	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
1.21	0.04	IE-ICP-AES	Cantagrel and Pin 1994[43]
1.287 <sup>#</sup>	0.038	INAA	Korotev 1996[45]
1.1	0.04	IE-ICP-AES	Rucandio 1997[66]
1.25 (n=10) 0.16 0.32 25.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
1 (n=8)	0.25	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

<sup>#</sup> Primary method**Table 49:** Summary of the published data for Sn in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<3*	not reported	ICP-AES	Church 1981[44]
0.48	not reported	SE-AAS	Terashima 1982[87] Jarvis and Williams 1989[47]
0.11*	not reported	SN-ICP-MS	
0.5-10 (n=11)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 50:** Summary of the published data for Sr in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
60	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
65.4*	1.3	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
62	not reported	WD-XRF	Sørensen 1981[88]
65	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
63	1	ED-XRF	Webb <i>et al.</i> 1990[72]
64	not reported	ICP-AES	Cantagrel and Pin 1994[43]
55.95	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
53.5	1.7	INAA	Korotev 1996[45]
62 <sup>#</sup>	2		
62 (n=9)		Median	
3		MADe	
6		Expanded uncertainty, k=2	
9.7		Relative expanded uncertainty, %	
62 (n=30)	14	Originally certified value	Steele <i>et al.</i> 1978[7]
59.9	1.6	ID-ICP-MS	Botha <i>et al.</i> 2007[53]

\* Incomplete dissolution

<sup>#</sup> Primary method**Table 51:** Summary of the published data for Ta in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.03 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60] Jarvis and Williams 1989[47]
0.2*	not reported	SN-ICP-MS	Poitrasson <i>et al.</i> 1993[83]
0.05	not reported	ICP-MS	Korotev 1996[45]
0.036 <sup>#</sup>	0.002		
0.043 (n=4)		Median	
0.015		MADe	
0.030		Expanded uncertainty, k=2	
69.8		Relative expanded uncertainty, %	
0.03-0.3 (n=5)		Range reported during certification	Steele <i>et al.</i> 1978[7]

<sup>#</sup> Primary method

\* Incomplete dissolution

**Table 52:** Summary of the published data for Tb in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.1 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<0.19	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.088 <sup>#</sup>	0.003	INAA	Korotev 1996[45]
1.7	0.4	IE-ICP-AES	Rucandio 1997[66]
0.10 (n=3) 0.02 0.04 40.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.05-0.11 (n=4)		Range reported during certification	Steele <i>et al.</i> 1978[7]

<sup>∞</sup> Primary method

**Table 53:** Summary of the published data for Th in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<25 <sup>*</sup>	not reported	ICP-AES	Church 1981[44]
0.73 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<3	not reported	WD-XRF	Robinson and Bennett 1981[86]
1.41 <sup>*</sup>	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
2	2	WD-XRF	Stork <i>et al.</i> 1987[40]
ND	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
0.691 <sup>#</sup>	0.020	INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.9 (n=9)	0.3	Provisional value	Steele <i>et al.</i> 1978[7]
1.0 (0.5-1.0) <sup>#</sup> (n=15)		Revised value	Hansen and Ring 1985[9]

<sup>\*</sup> Incomplete dissolution

<sup>∞</sup> Primary method

ND not detected

<sup>#</sup> 95% confidence interval

**Table 54:** Summary of the published data for Tm in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.01 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<0.5	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.013 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.011		Reported during certification	Steele <i>et al.</i> 1978[7]

<sup>∞</sup> Primary method

**Table 55:** Summary of the published data for U in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<20 <sup>*</sup>	not reported	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
4	not reported	WD-XRF	
0.39	0.03	Fluorimetry	Kanai <i>et al.</i> 1986[89]
ND	not reported	WD-XRF	Stork <i>et al.</i> 1987[40] Jarvis and Williams 1989[47]
0.65 <sup>*</sup>	not reported	SN-ICP-MS	
ND	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
0.41 <sup>#</sup>	0.02	INAA	Korotev 1996[45]
0.53 (n=4) 0.19 0.38 71.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.1-5.0 (n=13)		Range reported during certification	Steele <i>et al.</i> 1978[7]

<sup>\*</sup> Incomplete dissolution

ND not detected

<sup>∞</sup> Primary method

**Table 56:** Summary of the published data for V in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
10*	1	ICP-AES	Church 1981[44]
<1	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
137.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
139	10	IE-ICP-AES	Cantagrel and Pin 1994[43]
10 (n=18)	4	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 57:** Summary of the published data for W in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<7*	not reported	ICP-AES	Church 1981[44] Jarvis and Williams 1989[47]
<DL*	not reported	SN-ICP-MS	1989[47]
<1 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
<10 (n=2)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

DL detection limit

<sup>∞</sup> Primary method

**Table 58:** Summary of the published data for Y in SARM 2

Published values ( $\mu\text{g.g}^{-1}$ )	Standard deviation ( $\mu\text{g.g}^{-1}$ )	Analysis technique	Reference
16	not reported	WD-XRF	Robinson and Bennett 1981[86]
3	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
7	3	WD-XRF	Stork <i>et al.</i> 1987[40]
1.14	0.04	IE-ICP-AES	Jarvis and Jarvis 1988[62] Watkins and Nolan 1990[64]
1.1	not reported	IE-ICP-AES	1990[64]
8	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
14.3	not reported	ICP-AES	Cantagrel and Pin 1994[43]
16.2	0.9	IE-ICP-AES	Cantagrel and Pin 1994[43]
1.44	0.08	IE-ICP-AES	Cantagrel and Pin 1994[43]
1.4 <sup>#</sup>	not reported	INAA	Korotev 1996[45]
1.17	0.08	IE-ICP-AES	Rucandio 1997[66]
1.5-50 (n=10)		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during revision	Hansen and Ring 1985[9]

**Table 59:** Summary of the published data for Yb in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<0.2*	not reported	ICP-AES	Church 1981[44]
0.06 <sup>#</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
<1	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
0.08	0.01	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.1	0.01	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
0.06	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.12	0.01	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.07	0.01	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.067 <sup>#</sup>	0.007	INAA	Korotev 1996[45]
0.06	0.01	IE-ICP-AES	Rucandio 1997[66]
0.069 (n=8) 0.013 0.026 37.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.07 (n=6)	0.008	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

<sup>#</sup> Primary method



**Table 60:** Summary of the published data for Zn in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
ND	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
11.1	0.1	IE-AAS	Victor and Strelow 1980[85]
10.3*	1	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
14	not reported	WD-XRF	
9	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
83.15	not reported	ICP-AES	Cantagrel and Pin 1994[43]
74	7	IE-ICP-AES	Cantagrel and Pin 1994[43]
Not analysed <sup>#</sup>		INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
10 (n=22)	6	Provisional value	Steele <i>et al.</i> 1978[7]
8.9	0.4	ID-ICP-MS	Botha <i>et al.</i> 2007[53]

\* Incomplete dissolution

<sup>∞</sup> Primary method

**Table 61:** Summary of the published data for Zr in SARM 2

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
24	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
17*	1	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
16	not reported	WD-XRF	Watkins and Thompson 1983[55]
15	not reported	ICP-AES	Watkins and Thompson 1983[55]
15	not reported	ICP-AES	1983[55]
22	1	WD-XRF	Stork <i>et al.</i> 1987[40]
24	not reported	ED-XRF	Webb <i>et al.</i> 1990[72]
20	3	Spectrophotometric	Okai 1991[90]
129	not reported	ICP-AES	Cantagrel and Pin 1994[43]
124	9	IE-ICP-AES	Cantagrel and Pin 1994[43]
15 <sup>#</sup>	1	INAA	Korotev 1996[45]
20 (n=11) 6 12 60.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
33 (n=10)	20	Provisional value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

∞ Primary method

# Appendix C

## Compilation of SARM 3

**Table 1:** Summary of the published data for SiO<sub>2</sub> in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
52.5	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
52.53	0.07	WD-XRF	Stork <i>et al.</i> 1987[40]
51.25	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
52.4*	0.4	ICP-AES	Cantagrel and Pin 1994[43]
52.45 (n=4) 0.10 0.20 0.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
52.40 (n=52)	0.3	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 2:** Summary of the published data for Al<sub>2</sub>O<sub>3</sub> in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
13.35	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
13.43*	0.48	ICP-AES	Church 1981[44]
13.6	0.07	WD-XRF	Stork <i>et al.</i> 1987[40]
13.4	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
13.4*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
13.40 (n=5) 0.04 0.08 0.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
13.64 (n=57)	0.48	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 3:** Summary of the published data for total Fe as Fe<sub>2</sub>O<sub>3</sub> in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
9.7	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
10.22*	0.23	ICP-AES	Church 1981[44]
10.09	0.07	WD-XRF	Stork <i>et al.</i> 1987[40]
10.09	0.04	INAA	Bedard and Barnes 1990[91]
9.7	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
9.96*	0.09	ICP-AES	Cantagrel and Pin 1994[43]
9.92	not reported	INAA	Korotev 1996[45]
9.96 (n=7) 0.19 0.38 3.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
9.91 (n=67)	0.36	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 4:** Summary of the published data for MgO in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
0.24	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.263*	0.008	ICP-AES	Church 1981[44]
0.28	0.01	WD-XRF	Stork <i>et al.</i> 1987[40]
0.34	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.28*	0.01	ICP-AES	Cantagrel and Pin 1994[43]
0.28 (n=5) 0.03 0.06 21.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.28 (n=58)	0.10	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 5:** Summary of the published data for CaO in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
3.05	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
3.15*	0.1	ICP-AES	Church 1981[44]
3.14	0.02	WD-XRF	Stork <i>et al.</i> 1987[40]
3.09	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
3.21*	0.01	ICP-AES	Cantagrel and Pin 1994[43]
2.94	not reported	INAA	Korotev 1996[45]
3.12 (n=6) 0.07 0.14 4.5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
3.22 (n=72)	0.27	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 6:** Summary of the published data for Na<sub>2</sub>O in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
8.56*	0.27	ICP-AES	Church 1981[44] Bedard and Barnes 1990[91]
8.58	0.02	INAA	Verma <i>et al.</i> 1992[41]
8.11	not reported	WD-XRF	Cantagrel and Pin 1994[43]
8.18*	0.27	ICP-AES	Korotev 1996[45]
8.64	not reported	INAA	
8.56 (n=5) 0.12 0.24 2.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
8.37 (n=52)	0.53	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 7:** Summary of the published data for K<sub>2</sub>O in SARM 3

<b>Published values</b> <b>(% oxide)</b>	<b>Standard deviation</b> <b>(% oxide)</b>	<b>Analysis technique</b>	<b>Reference</b>
5.45*	0.14	ICP-AES	Church 1981[44]
5.55	not reported	WD-XRF	Galson <i>et al.</i> 1983[92]
5.39	0.02	WD-XRF	Stork <i>et al.</i> 1987[40]
5.24	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
5.57*	0.25	ICP-AES	Cantagrel and Pin 1994[43]
5.45 (n=5) 0.15 0.30 5.5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
5.51 (n=63)	0.19	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 8:** Summary of the published data for TiO<sub>2</sub> in SARM 3

<b>Published values</b> <b>(% oxide)</b>	<b>Standard deviation</b> <b>(% oxide)</b>	<b>Analysis technique</b>	<b>Reference</b>
0.48	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.493*	0.012	ICP-AES	Church 1981[44]
0.5	0.01	WD-XRF	Stork <i>et al.</i> 1987[40]
0.49	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.48*	0.01	ICP-AES	Cantagrel and Pin 1994[43]
0.49 (n=5) 0.01 0.02 4.1		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.48 (n=68)	0.08	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 9:** Summary of the published data for MnO in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
0.73	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.77*	0.02	ICP-AES	Church 1981[44]
0.73	0.01	WD-XRF	Stork <i>et al.</i> 1987[40]
0.72	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.75*	0.02	ICP-AES	Cantagrel and Pin 1994[43]
0.75	not reported	Spectrophotometry	Rao 1994[93]
0.74 (n=6)		Median	
0.02		MADe	
0.04		Expanded uncertainty, k=2	
5.4		Relative expanded uncertainty, %	
0.77 (n=67)	0.16	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 10:** Summary of the published data for P<sub>2</sub>O<sub>5</sub> in SARM 3

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
0.056	not reported	Spectrophotometry	Watkins 1979[46]
0.064*	0.003	ICP-AES	Church 1981[44]
0.05	0.005	WD-XRF	Stork <i>et al.</i> 1987[40]
0.05	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.076	not reported	ICP-AES	Cantagrel and Pin 1994[43]
0.085	0.004	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.06 (n=6)		Median	
0.01		MADe	
0.02		Expanded uncertainty, k=2	
33.3		Relative expanded uncertainty, %	
0.06 (n=34)	0.04	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution



**Table 11:** Summary of the published data for Ag in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<2*	not reported	ICP-AES	Church 1981[44]
9.45	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.11-2.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 12:** Summary of the published data for As in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<5*	not reported	ICP-AES	Church 1981[44]
1.92	not reported	HG-FAAS	Terashima 1986[48]
1.88	0.03	SN-ICP-MS	Jarvis and Williams 1989[47]
<DL	not reported	INAA	Bedard and Barnes 1990[91]
1.70	not reported	INAA	Korotev 1996[45]
1.0-14		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

DL =detection limit

**Table 13:** Summary of the published data for Au in SARM 3

Published values (ng.g <sup>-1</sup> )	Standard deviation (ng.g <sup>-1</sup> )	Analysis technique	Reference
<4000*	not reported	ICP-AES	Church 1981[44]
0.64*	0.1	GF-AAS	Terashima 1988[49]
<10	not reported	INAA	Korotev 1996[45]
4.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

**Table 14:** Summary of the published data for B in SARM 3

Published values (µg.g <sup>-1</sup> )	Standard deviation (µg.g <sup>-1</sup> )	Analysis technique	Reference
3.3*	not reported	ICP-AES	Walsh 1985[51] Jarvis and Williams 1989[47]
8.37	0.62	SN-ICP-MS	
3.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

**Table 15:** Summary of the published data for Ba in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
372	4	IEC	Strelow <i>et al.</i> 1978[94]
510	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
420*	8.4	ICP-AES	Church 1981[44]
389	not reported	WD-XRF	Robinson and Bennett 1981[86]
430	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
437 <sup>∞</sup>	23	INAA	Bedard and Barnes 1990[91]
420.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
450	2.25	IE-ICP-AES	Cantagrel and Pin 1994[43]
410 <sup>∞</sup>	not reported	INAA	Korotev 1996[45]
420.5 (n=9)		Median	
24.5		MADe	
49.0		Expanded uncertainty, k=2	
11.7		Relative expanded uncertainty, %	
450 (n=33)	140	Originally certified value	Steele <i>et al.</i> 1978[7]
413.4 <sup>∞</sup>	3.3	ID-ICP-MS	This work

\* Incomplete dissolution

<sup>∞</sup> Primary method**Table 16:** Summary of the published data for Be in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
25.8	0.5	IEC	Strelow <i>et al.</i> 1978[94]
29.7*	0.6	ICP-AES	Church 1981[44]
27	not reported	ICP-AES	Watkins and Thompson 1983[55]
24.3	1.2	SE-Spectrophotometry	Sauerer and Troll 1984[95]
24.2	0.82	SN-ICP-MS	Jarvis and Williams 1989[47]
25.8 (n=5)		Median	
2.2		MADe	
4.4		Expanded uncertainty, k=2	
17.1		Relative expanded uncertainty, %	
2.0-31.0		Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 17:** Summary of the published data for Bi in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.25	not reported	FD-AAS	Heinrichs 1979[56]
<25 <sup>*</sup>	not reported	ICP-AES	Church 1981[44]
0.468	not reported	SE-HG-AAS	Terashima 1984[57]
1.76	0.22	SN-ICP-MS	Jarvis and Williams 1989[47]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.4		Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 18:** Summary of the published data for Cd in SARM 3

Published values ( $\text{ng}\cdot\text{g}^{-1}$ )	Standard deviation ( $\text{ng}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
630	not reported	FD-Flameless AAS	Heinrichs 1979[56]
1005 <sup>∞</sup>	82	IE-ID-MS	Rosman and De Laeter[58] 1980
<2000 <sup>*</sup>	not reported	ICP-AES	Church 1981[44]
930	10	SN-ICP-MS	Jarvis and Williams 1989[47]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
2000-4000		Range reported during certification	Steele <i>et al.</i> 1978[7]

<sup>∞</sup> Primary method

\* Incomplete dissolution

**Table 19:** Summary of the published data for Ce in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
210	5	IE-CES	Mazzucotelli and Vannucci 1980[59]
311*	6.2	ICP-AES	Church 1981[44]
308	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
313	not reported	WD-XRF	
307	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61] Date and Hutchinson 1987[96]
300	not reported	ICP-MS	
245	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
262	13	IE-ICP-AES	Jarvis and Jarvis 1988[62]
231	not reported	SN-ICP-MS	Jarvis 1989[97]
272	1	INAA	Bedard and Barnes 1990[91]
292	2	IE-ICP-AES	Roelandts 1990[63]
270	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
257	7	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
639.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
693	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
298	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
249	6	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
293	not reported	INAA	Korotev 1996[45]
291	8	IE-ICP-AES	Rucandio 1997[66]
248	not reported	ICP-MS	Brenner <i>et al.</i> 1999[99]
292 (n=20)		Median	
32		MADe	
64		Expanded uncertainty, k=2	
21.9		Relative expanded uncertainty, %	
230 (n=13)	43	Provisional value	Steele <i>et al.</i> 1978[7]
240 (n=18)	42	Revised value	Hansen and Ring 1985[9]

\* Incomplete dissolution

**Table 20:** Summary of the published data for Cl in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
902	not reported	LE-CIC (LECO)	Evans and Moore 1980[100]
1100	not reported	SN-ICP-MS	Jarvis 1992[101]
1200 (n=6)	500	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele and Hansen 1979[8]

**Table 21:** Summary of the published data for Co in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<1*	not reported	ICP-AES	Church 1981[44]
2.4	not reported	INAA	Potts <i>et al.</i> 1981[60]
4	not reported	WD-XRF	Robinson and Bennett 1981[86]
2.61	0.11	IE-FAAS	Anderson and Victor 1986[67]
2.44	0.04	IE-FAAS	Victor 1986[68]
3.5	0.4	INAA	Bedard and Barnes 1990[91]
2.3	not reported	INAA	Korotev 1996[45]
2.53 (n=6) 0.26 0.52 20.6  1.6-150		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 22:** Summary of the published data for Cr in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
12.1*	1.2	ICP-AES	Church 1981[44]
10	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
12	0.42	SN-ICP-MS	Jarvis and Williams 1989[47]
11 <sup>∞</sup>	2	INAA	Bedard and Barnes 1990[91]
15.15	not reported	ICP-AES	Cantagrel and Pin 1994[43]
14.8	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
9	not reported	INAA	Korotev 1996[45]
12 (n=7) 3 6 50.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
10 (n=27)	14	Provisional value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 23:** Summary of the published data for Cs in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2.43	0.09	Flame emission	Goguel 1981[69]
2.78	not reported	Flame emission	Terashima and Mita 1981[70]
3.4	0.2	INAA	Bedard and Barnes 1990[91]
2.63	not reported	INAA	Korotev 1996[45]
2.71 (n=4) 0.26 0.52 19.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
2.1-9		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 24:** Summary of the literature data for Cu in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
13.3*	1.3	ICP-AES	Church 1981[44]
<2	not reported	WD-XRF	Robinson and Bennett 1981[86]
10.31	0.03	IE-AAS	Victor 1983[71]
8.2	not reported	ICP-AES	Cantagrel and Pin 1994[43]
11.2	0.3	IE-ICP-AES	Cantagrel and Pin 1994[43]
10.8 (n=4) 2.2 4.4 40.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
13 (n=33)	6	Originally certified value	Steele <i>et al.</i> 1978[7]
9.85	0.76	ID-ICP-MS	This work

\* Incomplete dissolution



**Table 25:** Summary of the published data for Dy in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
10	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61] Date and Hutchinson 1987[96]
2.9	not reported	ICP-MS	Jarvis and Jarvis 1988[62]
3.1	0.22	IE-ICP-AES	Jarvis 1989[97]
2.69	not reported	SN-ICP-MS	Roelandts 1990[63] Watkins and Nolan 1990[64]
3.3	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
2.75	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
2.6	0.3	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
2.69	not reported	IE-ICP-AES	Korotev 1996[45]
3.01	0.23	IE-ICP-AES	Rucandio 1997[66]
3.1	not reported	INAA	Brenner <i>et al.</i> 1999[99]
2.9	0.3	IE-ICP-AES	
2.9	not reported	ICP-MS	
2.9 (n=12) 0.3 0.6 20.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
1.9-3.719		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 26:** Summary of the published data for Er in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2.1	not reported	ICP-MS	Date and Hutchinson 1987[96]
2.58	0.24	IE-ICP-AES	Jarvis and Jarvis 1988[62]
2.26	not reported	SN-ICP-MS	Jarvis 1989[97]
1.55	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
2.23	0.04	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
2.6	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
2.45	0.21	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
2.3	not reported	INAA	Korotev 1996[45]
2.3	0.2	IE-ICP-AES	Rucandio 1997[66]
2.2	not reported	ICP-MS	Brenner <i>et al.</i> 1999[99]
2.28 (n=10)		Median	
0.19		MADe	
0.38		Expanded uncertainty, k=2	
16.7		Relative expanded uncertainty, %	
1.2-2.3		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 27:** Summary of the published data for Eu in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2.1*	0.2	ICP-AES	Church 1981[44]
0.9	not reported	IE-GF-AAS	Horsky and Fletcher 1981[102]
1.15	not reported	INAA	Potts <i>et al.</i> 1981[60]
3.8	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
1	not reported	ICP-MS	Date and Hutchinson 1987[96]
1.05	0.07	IE-ICP-AES	Jarvis and Jarvis 1988[62]
1*	not reported	SN-ICP-MS	Jarvis 1989[97]
1	0.2	INAA	Bedard and Barnes 1990[91]
1.16	0.01	IE-ICP-AES	Roelandts 1990[63]
0.95	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
1	0.08	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
1.06	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
1.13	0.13	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
1.082	not reported	INAA	Korotev 1996[45]
1.21	0.04	IE-ICP-AES	Rucandio 1997[66]
1.4	not reported	ICP-MS	Brenner <i>et al.</i> 1999[99]
1.07 (n=16)		Median	
0.11		MADe	
0.22		Expanded uncertainty, k=2	
20.6		Relative expanded uncertainty, %	
1.2 (1.0-1.5) # (n=15)		Revised value	Hansen and Ring 1985[9]

\* Incomplete dissolution

# 95 % confidence interval

**Table 28:** Summary of the published data for F in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
3185	10	ISE	Troll and Farzenah 1978[73]
5500 <sup>oo</sup>	230	INAA	Esprit <i>et al.</i> 1984[74]
4783	not reported	PIGE	Roelandts <i>et al.</i> 1985[75]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
4400 (n=11)	1500	Originally certified value	Steele and Hansen 1979[8]

**Table 29:** Summary of the published data for Ga in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
54	not reported	WD-XRF	Robinson and Bennett 1981[86]
51.1	0.4	IE-FAAS	Van der Walt and Strelow 1984[76]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
54 (n=12)	98	Provisional value	Steele <i>et al.</i> 1978[7]

**Table 30:** Summary of the published data for Gd in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
3*	0.3	ICP-AES	Church 1981[44]
3.6	not reported	INAA	Potts <i>et al.</i> 1981[60]
7	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61] Date and Hutchinson 1987[96]
4	not reported	ICP-MS	Jarvis and Jarvis 1988[62]
3.59	0.44	IE-ICP-AES	Jarvis 1989[97]
4.13	not reported	SN-ICP-MS	Roelandts 1990[63] Watkins and Nolan 1990[64]
3	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
2.35	not reported	IE-ICP-AES	Cantagrel and Pin 1994[43]
4.4	0.5	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
2.5	0.1	IE-ICP-AES	Korotev 1996[45]
3.18	0.34	IE-ICP-AES	Rucandio 1997[66]
2.6	not reported	INAA	Brenner <i>et al.</i> 1999[99]
3.8	0.9	IE-ICP-AES	
4	0.04	ICP-MS	
3.60 (n=14)		Median	
0.84		MADe	
1.68		Expanded uncertainty, k=2	
46.7		Relative expanded uncertainty, %	
1.799-3.6		Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 31:** Summary of the published data for Ge in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.76	0.02	SN-ICP-MS	Jarvis and Williams 1989[47]
0.89	0.05	SE-HG-ICP-AES	Halicz 1990[103]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele <i>et al.</i> 1978[7]

**Table 32:** Summary of the published data for Hf in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
231	not reported	INAA	Potts <i>et al.</i> 1981[60]
220.2	0.4	INAA	Bedard and Barnes 1990[91]
220	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
235	not reported	INAA	Korotev 1996[45]
226 (n=4) 8 16 7.1		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]
148-274			

**Table 33:** Summary of the published data for Hg in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
23.9	0.85	FAAS	Flanagan <i>et al.</i> 1982[77]
44.5*	1.2	HG-FAAS	Chan and Bina 1989[78]
24	2	CV-AAS	Terashima 1994[79]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
		Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 34:** Summary of the published data for Ho in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.5	not reported	ICP-MS	Date and Hutchinson 1987[96]
0.91	0.12	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.64	not reported	SN-ICP-MS	Jarvis 1989[97] Watkins and Nolan 1990[64]
0.55	not reported	IE-ICP-AES	1990[64]
<0.7	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.77	0.13	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.74	not reported	INAA	Korotev 1996[45]
0.59	0.07	IE-ICP-AES	Rucandio 1997[66]
0.6	0.01	ICP-MS	Brenner <i>et al.</i> 1999[99]
0.62 (n=8) 0.14 0.28 45.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.42-0.9		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 35:** Summary of the published data for La in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
300	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
232*	4.6	ICP-AES	Church 1981[44] Horsky and Fletcher 1981[102]
123	not reported	IE-GF-AAS	
228	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
268	not reported	WD-XRF	
236	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
250	not reported	Revised value	Hansen and Ring 1985[9] Date and Hutchinson 1987[96]
240	not reported	ICP-MS	
219	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
201	9	IE-ICP-AES	Jarvis and Jarvis 1988[62]
160	not reported	SN-ICP-MS	Jarvis 1989[97] Bedard and Barnes 1990[91]
222.3	0.4	INAA	
232	1	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
215	not reported	IE-ICP-AES	
288	8	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
223.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
234	13	IE-ICP-AES	Cantagrel and Pin 1994[43]
231	3	IE-ICP-AES	Cantagrel and Pin 1994[43]
242	10	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
228	not reported	INAA	Korotev 1996[45]
217	5	IE-ICP-AES	Rucandio 1997[66]
248	2	ICP-MS	Brenner <i>et al.</i> 1999[99]
231 (n=21) 16 32 13.9		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
250 (n=12)	42	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution



**Table 36:** Summary of the published data for Li in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
43.4	0.6	IEC	Strelow <i>et al.</i> 1978[94]
55	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
39.3*	0.78	ICP-AES	Church 1981[44]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
48 (n=10)	20	Provisional value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 37:** Summary of the published data for Lu in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.41 <sup>∞</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.5	not reported	ICP-MS	Date and Hutchinson 1987[96]
0.38	0.02	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.41	not reported	SN-ICP-MS	Jarvis 1989[97]
0.55	0.02	INAA	Bedard and Barnes 1990[91]
0.51	0.01	IE-ICP-AES	Roelandts 1990[63]
0.7	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
0.53	0.06	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.47	0.04	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.47	0.06	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.47	not reported	INAA	Korotev 1996[45]
0.48	0.02	IE-ICP-AES	Rucandio 1997[66]
0.4	0.01	ICP-MS	Brenner <i>et al.</i> 1999[99]
0.47 (n=13) 0.09 0.18 38.3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.4 (n=7)	0.2	Revised value (provisional)	Hansen and Ring 1985

**Table 38:** Summary of the published data for Mo in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<5*	not reported	ICP-AES	Church 1981[44]
1.3	0.14	SE-ICP-AES	Thompson and Zao 1985[104]
0.75	0.08	SN-ICP-MS	Jarvis and Williams 1989[47]
0.920-5 1.82	0.41	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification ID-ICP-MS	Steele <i>et al.</i> 1978[7] This work

\* Incomplete dissolution

**Table 39:** Summary of the published data for Nb in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
1002	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
991	not reported	WD-XRF	Robinson and Bennett 1981[86]
985	42	WD-XRF	Stork <i>et al.</i> 1987[40]
932	22	SN-ICP-MS	Jarvis and Williams 1989[47]
953.7	not reported	WD-XRF	Harvey 1992[105]
985 (n=5) 25 50 5.1  960 (n=12)	570	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele <i>et al.</i> 1978[7]

**Table 40:** Summary of the published data for Nd in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
49*	10	ICP-AES	Church 1981[44]
54.8	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
59	not reported	WD-XRF	
60	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61] Date and Hutchinson 1987[96]
52	not reported	ICP-MS	
50	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
43.1	2.1	IE-ICP-AES	Jarvis and Jarvis 1988[62]
39.6	not reported	SN-ICP-MS	Jarvis 1989[97] Bedard and Barnes 1990[91]
44	1	INAA	
52	1	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
45.5	not reported	IE-ICP-AES	
45	1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
47.2	0.8	IE-ICP-AES	Cantagrel and Pin 1994[43]
50.3	4.6	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
48	not reported	INAA	Korotev 1996[45]
48	0.3	IE-ICP-AES	Rucandio 1997[66]
43	0.2	ICP-MS	Brenner <i>et al.</i> 1999[99]
48 (n=17) 6 12 25.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
48 (35-57) <sup>#</sup> (n=11)		Revised value	Hansen and Ring 1985[9]

\* Incomplete dissolution

<sup>#</sup> 95% confidence interval

**Table 41:** Summary of the published data for Ni in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
57	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
7*	1	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
<3	not reported	WD-XRF	1981[86]
3	1	WD-XRF	Stork <i>et al.</i> 1987[40]
2.16	0.29	IE-FAAS	Victor 1987[84] Bedard and Barnes 1990[91]
<DL	not reported	INAA	1990[91]
4.25	not reported	ICP-AES	Cantagrel and Pin 1994[43]
4.1	1.5	IE-ICP-AES	Cantagrel and Pin 1994[43]
<50	not reported	INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
2-150		Range reported during certification	Steele <i>et al.</i> 1978[7]
1.54	0.27	ID-ICP-MS	This work

**Table 42:** Summary of the published data for Pb in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
48.6	0.3	IE-AAS	Victor and Strelow 1980[85]
68*	7	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
44	not reported	XRF	1981[86]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
43 (n=28)	17	Originally certified value	Steele <i>et al.</i> 1978[7]
46.04	0.66	ID-ICP-MS	This work

\* Incomplete dissolution

**Table 43:** Summary of the published data for Pr in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
2.43	0.09	Flame emission	Goguel 1981[69]
21.5	not reported	INAA	Potts <i>et al.</i> 1981[60]
<15	not reported	WD-XRF	Robinson and Bennett 1981[86]
21	not reported	ICP-MS	Date and Hutchinson 1987[96]
16.4	1.1	IE-ICP-AES	Jarvis and Jarvis 1988[62]
16.9	not reported	SN-ICP-MS	Jarvis 1989[97]
19	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
16.8	0.7	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
19.9	0.5	IE-ICP-AES	Cantagrel and Pin 1994[43]
17.4	0.8	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
20	not reported	INAA	Korotev 1996[45]
19	2	IE-ICP-AES	Rucandio 1997[66]
18	0.1	ICP-MS	Brenner <i>et al.</i> 1999[99]
18.5 (n=12)		Median	
2.3		MADe	
4.6		Expanded uncertainty, k=2	
24.9		Relative expanded uncertainty, %	
15-21.5		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 44:** Summary of the published data for Rb in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
248	not reported	XRF	Vié le Sage <i>et al.</i> 1979[82]
293	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
201	not reported	XRF	Robinson and Bennett 1981[86]
191.1	not reported	XRF	Galson <i>et al.</i> 1983[92]
198	3	XRF	Stork <i>et al.</i> 1987[40]
191 <sup>o</sup>	4	INAA	Bedard and Barnes 1990[91]
198 <sup>o</sup>	not reported	INAA	Korotev 1996[45]
198 (n=7)		Median	
10		MADe	
20		Expanded uncertainty, k=2	
10.1		Relative expanded uncertainty, %	
190 (n=24)	350	Originally certified value	Steele <i>et al.</i> 1978[7]

**Table 45:** Summary of the published data for S in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
537	not reported	Infrared photometry	Terashima 1978[106]
		Median	
		MADe	
		Expanded uncertainty, k=2	
		Relative expanded uncertainty, %	
650 (n=10)	170	Provisional value	Steele <i>et al.</i> 1978[7]

**Table 46:** Summary of the published data for Sb in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<14*	not reported	ICP-AES	Church 1981[44]
0.13	not reported	HG-FAAS	Terashima 1986[48]
0.36	0.06	SN-ICP-MS	Jarvis and Williams 1989[47]
0.19	0.03	INAA	Bedard and Barnes 1990[91]
0.11	not reported	INAA	Korotev 1996[45]
0.16 (n=4) 0.06 0.12 75.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.190-2.469		Range reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

**Table 47:** Summary of the published data for Sc in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
4	not reported	IE-ICP-AES	Bolton <u>et al.</u> 1983[61]
0.22	0.01	INAA	Bedard and Barnes 1990[91]
0.5	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
1.925	not reported	ICP-AES	Cantagrel and Pin 1994[43]
1.87	0.19	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.186	not reported	INAA	Korotev 1996[45]
1.19 (n=6) 1.26 2.52 211.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.260-80		Range reported during certification	Steele <u>et al.</u> 1978[7]

**Table 48:** Summary of the published data for Sm in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
7.5*	1.5	ICP-AES	Church 1981[44]
6.2	not reported	IE-GF-AAS	Horsky and Fletcher 1981[102]
5.6	not reported	INAA	Potts <i>et al.</i> 1981[60]
<10	not reported	WD-XRF	Robinson and Bennett 1981[86]
15	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
4.6	not reported	ICP-MS	Date and Hutchinson 1987[96]
3.53	0.42	IE-ICP-AES	Jarvis and Jarvis 1988[62]
3.76	not reported	SN-ICP-MS	Jarvis 1989[97]
5.18	0.02	INAA	Bedard and Barnes 1990[91]
4.4	0.1	IE-ICP-AES	Roelandts 1990[63]
3.8	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
3.1	0.2	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
4.22	0.03	IE-ICP-AES	Cantagrel and Pin 1994[43]
4.7	0.4	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
4.48	not reported	INAA	Korotev 1996[45]
4.9	0.6	IE-ICP-AES	Rucandio 1997[66]
4.2	0.06	ICP-MS	Brenner <i>et al.</i> 1999[99]
4.5 (n=16)		Median	
1.0		MADe	
2.0		Expanded uncertainty, k=2	
44.4		Relative expanded uncertainty, %	
5 (n=10)	2	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution



**Table 49:** Summary of the published data for Sn in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
12 <sup>*</sup>	2	ICP-AES	Church 1981[44]
7.4	not reported	SE-AAS	Terashima 1982[87]
6.9	0.16	SN-ICP-MS	Jarvis and Williams 1989[47]
0.720-12		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 50:** Summary of the published data for Sr in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
4680	10	IEC	Strelow <i>et al.</i> 1978[94]
5300	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
4690 <sup>*</sup>	94	ICP-AES	Church 1981[44]
4192	not reported	WD-XRF	Robinson and Bennett 1981[86]
4545	not reported	WD-XRF	Sørensen 1981[88]
4420	27	WD-XRF	Stork <i>et al.</i> 1987[40]
4586.7	not reported	WD-XRF	Harvey 1992[105]
5420	not reported	ICP-AES	Cantagrel and Pin 1994[43]
5000	325	IE-ICP-AES	Cantagrel and Pin 1994[43]
4782	not reported	INAA	Korotev 1996[45]
4685 (n=10) 300 600 12.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele <i>et al.</i> 1978[7]
4600 (n=34) 4728	1000 60	ID-ICP-MS	This work

\* Incomplete dissolution

**Table 51:** Summary of the published data for Ta in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
25.2	not reported	INAA	Potts <i>et al.</i> 1981[60]
18.8	0.62	SN-ICP-MS	Jarvis and Williams 1989[47]
23.7	0.2	INAA	Bedard and Barnes 1990[91]
22.1	not reported	INAA	Korotev 1996[45]
22.9 (n=4) 2.3 4.6 20.1		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
21-26.2		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 52:** Summary of the published data for Tb in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.54 <sup>∞</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.6	not reported	ICP-MS	Date and Hutchinson 1987[96]
0.43	not reported	SN-ICP-MS	Jarvis 1989[97]
0.65	0.09	INAA	Bedard and Barnes 1990[91]
<0.5	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.64	0.07	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.45	not reported	INAA	Korotev 1996[45]
0.82	0.09	IE-ICP-AES	Rucandio 1997[66]
0.6	0.001	ICP-MS	Brenner <i>et al.</i> 1999[99]
0.60 (n=8) 0.08 0.16 26.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.7 (n=9)	0.2	Revised value (provisional)	Hansen and Ring 1985[9]

**Table 53:** Summary of the published data for Th in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
55 <sup>*</sup>	8.3	ICP-AES	Church 1981[44]
69	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
68	not reported	WD-XRF	Galson <i>et al.</i> 1983[92]
63.9	not reported	WD-XRF	Jarvis and Williams 1989[47]
58.3	2.4	SN-ICP-MS	Bedard and Barnes 1990[91]
66.9	0.2	INAA	
61.4	not reported	INAA	Korotev 1996[45]
64 (n=7)		Median	
6		MADe	
12		Expanded uncertainty, k=2	
18.8		Relative expanded uncertainty, %	
65 (n=18)	24	Originally certified value	Steele <i>et al.</i> 1978[7]
66 (58-72) <sup>#</sup> (n=21)		Revised value	Hansen and Ring 1985[9]

\* Incomplete dissolution

# 95% confidence interval

**Table 54:** Summary of the published data for Tm in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
0.27	not reported	INAA	Potts <i>et al.</i> 1981[60] Date and Hutchinson 1987[96]
0.4	not reported	ICP-MS	Jarvis 1989[97]
0.37	not reported	SN-ICP-MS	Bauer-Wolf <i>et al.</i> 1993[65]
<1.3	not reported	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.17	0.03	IE-ICP-AES	Korotev 1996[45]
0.38	not reported	INAA	
0.4	0.01	ICP-MS	Brenner <i>et al.</i> 1999[99]
0.38 (n=6)		Median	
0.04		MADe	
0.08		Expanded uncertainty, k=2	
21.1		Relative expanded uncertainty, %	
0.230-0.900		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 55:** Summary of the published data for U in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
14	not reported	Originally certified value	Steele <i>et al.</i> 1978[7]
12.9	0.4	IEC	Strelow <i>et al.</i> 1978[94]
<20*	not reported	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
15	not reported	WD-XRF	Galson <i>et al.</i> 1983[92]
13.49	not reported	WD-XRF	
15.3	1.4	Fluorimetry	Kanai <i>et al.</i> 1986[89]
17	1	Extractive photometry	Kanai <i>et al.</i> 1986[89] Jarvis and Williams 1989[47]
18.1	0.8	SN-ICP-MS	Bedard and Barnes 1990[91]
17.9	0.2	INAA	
18.3	not reported	INAA	Korotev 1996[45]
16.2 (n=8) 2.7 5.4 33.3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
14 (n=11)	7	Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 56:** Summary of the published data for V in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
72.4	0.5	IEC	Strelow <i>et al.</i> 1978[94]
82*	2.5	ICP-AES	Church 1981[44]
88.65	not reported	ICP-AES	Cantagrel and Pin 1994[43]
92.5	4	IE-ICP-AES	Cantagrel and Pin 1994[43]
85 (n=4) 8 16 18.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
81 (n=32)	18	Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 57:** Summary of the published data for W in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
<8*	not reported	ICP-AES	Church 1981[44] Jarvis and Williams 1989[47]
7.72	0.19	SN-ICP-MS	1989[47]
8	not reported	INAA	Korotev 1996[45]
10		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 58:** Summary of the published data for Y in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
19	not reported	WD-XRF	Robinson and Bennett 1981[86]
24	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
13	14	WD-XRF	Stork <i>et al.</i> 1987[40]
17	1	IE-ICP-AES	Jarvis and Jarvis 1988[62]
16.6	not reported	SN-ICP-MS	Jarvis 1989[97] Watkins and Nolan 1990[64]
18.8	not reported	IE-ICP-AES	1990[64]
21.85	not reported	ICP-AES	Cantagrel and Pin 1994[43]
22.9	0.6	IE-ICP-AES	Cantagrel and Pin 1994[43]
20.1	0.9	IE-ICP-AES	Cantagrel and Pin 1994[43]
22	not reported	INAA	Korotev 1996[45]
22	9	IE-ICP-AES	Rucandio 1997[66]
20 (n=11) 3 6 30.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
25 (n=11)	17	Provisional value	Steele <i>et al.</i> 1978[7]
22 (15-27) <sup>#</sup> (n=17)		Revised value	Hansen and Ring 1985[9]

<sup>#</sup> 95% confidence interval

**Table 59:** Summary of the published data for Yb in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
3*	0.1	ICP-AES	Church 1981[44] Horsky and Fletcher 1981[102]
3.8	not reported	IE-GF-AAS	
3.4	not reported	INAA	Potts <i>et al.</i> 1981[60]
4	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61] Date and Hutchinson 1987[96]
2.4	not reported	ICP-MS	
2.45	0.19	IE-ICP-AES	Jarvis and Jarvis 1988[62]
2.67	not reported	SN-ICP-MS	Jarvis 1989[97]
3.14	0.04	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
2.6	not reported	IE-ICP-AES	
2.7	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
2.95	0.05	IE-ICP-AES	Cantagrel and Pin 1994[43]
2.86	0.12	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
2.84	not reported	INAA	Korotev 1996[45]
3.2	0.6	IE-ICP-AES	Rucandio 1997[66]
3.6	0.02	ICP-MS	Brenner <i>et al.</i> 1999[99]
2.95 (n=15) 0.42 0.84 28.5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
3 (n=11)	1	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

**Table 60:** Summary of the published data for Zn in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
514	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
429	1	IE-AAS	Victor and Strelow 1980[85]
439 <sup>*</sup>	13	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
401	not reported	WD-XRF	1981[86]
436.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
448	11	IE-ICP-AES	Cantagrel and Pin 1994[43]
425	not reported	INAA	Korotev 1996[45]
437 (n=7) 16 32 7.3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
395 (n=30)	119	Originally certified value	Steele <i>et al.</i> 1978[7]
430.0	5.2	ID-ICP-MS	This work

<sup>\*</sup> Incomplete dissolution

**Table 61:** Summary of the published data for Zr in SARM 3

Published values ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Standard deviation ( $\mu\text{g}\cdot\text{g}^{-1}$ )	Analysis technique	Reference
15900	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
11600*	350	ICP-AES	Church 1981 Watkins and Thompson 1983[55]
12000	not reported	ICP-AES	1983[55]
10000	110	WD-XRF	Stork <i>et al.</i> 1987[40] Bedard and Barnes 1990[91]
11189	109	INAA	1990[91]
11400	100	Spectrometric	Okai 1991[90]
10950.7	not reported	WD-XRF	Harvey 1992[105]
9900	not reported	ICP-AES	Cantagrel and Pin 1994[43]
11700	470	IE-ICP-AES	Cantagrel and Pin 1994[43]
11329	not reported	INAA	Korotev 1996[45]
11329 (n=11)		Median	
550		MADe	
1100		Expanded uncertainty, k=2	
9.7		Relative expanded uncertainty, %	
11000 (n=31)	5000	Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution



# Appendix D

## Compilation of SARM 4

**Table 1:** Summary of the published data for SiO<sub>2</sub> in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
52.6	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
53.6	not reported	ICP-AES	Walsh 1980[39]
52.68	0.15	WD-XRF	Stork <i>et al.</i> 1987[40]
52.82	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
52.83	not reported	XRF	Couture <i>et al.</i> 1993[42]
53*	0.4	ICP-AES	Cantagrel and Pin 1994[43]
52.83 (n=6) 0.24 0.48 0.9		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
52.64 (n=71)	0.74	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 2:** Summary of the published data for Al<sub>2</sub>O<sub>3</sub> in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
16.5	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
16.37	not reported	ICP-AES	Walsh 1980[39]
16.39*	0.59	ICP-AES	Church 1981[44]
16.58	0.05	WD-XRF	Stork <i>et al.</i> 1987[40]
16.74	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
16.6	not reported	XRF	Couture <i>et al.</i> 1993[42]
16.5*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
16.50 (n=7) 0.15 0.30 1.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
16.5 (n=74)	0.6	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 3:** Summary of the published data for total Fe as Fe<sub>2</sub>O<sub>3</sub> in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
8.85	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
8.76	not reported	ICP-AES	Walsh 1980[39]
8.71*	0.19	ICP-AES	Church 1981[44]
9.1	0.05	WD-XRF	Stork <i>et al.</i> 1987[40]
9.22	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
8.99	not reported	XRF	Couture <i>et al.</i> 1993[42]
8.96*	0.06	ICP-AES	Cantagrel and Pin 1994[43]
8.96	not reported	INAA	Korotev 1996[45]
8.96 (n=8) 0.19 0.38 4.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
8.97 (n=73)	0.90	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 4:** Summary of the published data for MgO in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
7.47	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
7.37	not reported	ICP-AES	Walsh 1980[39]
7.53*	0.23	ICP-AES	Church 1981[44]
7.51	0.05	WD-XRF	Stork <i>et al.</i> 1987[40]
7.58	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
7.41	not reported	XRF	Couture <i>et al.</i> 1993[42]
7.29*	0.07	ICP-AES	Cantagrel and Pin 1994[43]
7.47 (n=8) 0.09 0.18 2.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
7.5 (n=74)	0.7	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 5:** Summary of the published data for CaO in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
11.43	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
11.46	not reported	ICP-AES	Walsh 1980[39]
10.94*	0.36	ICP-AES	Church 1981[44]
11.4	0.3	WD-XRF	Stork <i>et al.</i> 1987[40]
11.45	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
11.58	not reported	XRF	Couture <i>et al.</i> 1993[42]
11.7*	not reported	ICP-AES	Cantagrel and Pin 1994[43]
11.45	not reported	INAA	Korotev 1996[45]
11.45 (n=8) 0.05 0.10 0.9		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
11.5 (n=78)	0.4	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 6:** Summary of the published data for Na<sub>2</sub>O in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
2.38	not reported	ICP-AES	Walsh 1980[39]
2.47*	0.08	ICP-AES	Church 1981[44]
2.43	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
2.28	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
2.54	not reported	XRF	Couture <i>et al.</i> 1993[42]
2.42*	0.08	ICP-AES	Cantagrel and Pin 1994[43]
2.48	not reported	INAA	Korotev 1996[45]
2.43 (n=7) 0.07 0.14 5.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
2.46 (n=54)	0.17	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 7:** Summary of the published data for K<sub>2</sub>O in SARM 4

<b>Published values</b> <b>(% oxide)</b>	<b>Standard deviation</b> <b>(% oxide)</b>	<b>Analysis technique</b>	<b>Reference</b>
0.47	not reported	ICP-AES	Walsh 1980[39]
0.258*	0.007	ICP-AES	Church 1981[44]
0.24	0.01	WD-XRF	Stork <i>et al.</i> 1987[40]
0.25	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.24	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.25*	0.07	ICP-AES	Cantagrel and Pin 1994[43]
0.25 (n=6) 0.01 0.02 8.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.25 (n=63)	0.07	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 8:** Summary of the published data for TiO<sub>2</sub> in SARM 4

<b>Published values</b> <b>(% oxide)</b>	<b>Standard deviation</b> <b>(% oxide)</b>	<b>Analysis technique</b>	<b>Reference</b>
0.19	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.19	not reported	ICP-AES	Walsh 1980[39]
0.185*	0.005	ICP-AES	Church 1981[44]
0.2	0.01	WD-XRF	Stork <i>et al.</i> 1987[40]
0.49	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.2	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.19*	0.006	ICP-AES	Cantagrel and Pin 1994[43]
0.19 (n=7) 0.01 0.02 10.5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.20 (n=65)	0.03	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 9:** Summary of the published data for MnO in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
0.18	not reported	ICP-AES	Brenner <i>et al.</i> 1980[38]
0.17	not reported	ICP-AES	Walsh 1980[39]
0.18*	0.005	ICP-AES	Church 1981[44]
0.18	0.002	WD-XRF	Stork <i>et al.</i> 1987[40]
0.19	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.19	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.18*	0.006	ICP-AES	Cantagrel and Pin 1994[43]
0.18 (n=7) 0.01 0.02 11.1		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.18 (n=69)	0.01	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 10:** Summary of the published data for P<sub>2</sub>O<sub>5</sub> in SARM 4

Published values (% oxide)	Standard deviation (% oxide)	Analysis technique	Reference
0.035	not reported	Spectrophotometric	Watkins 1979[46]
0.03	not reported	ICP-AES	Walsh 1980[39]
0.018*	0.002	ICP-AES	Church 1981[44]
0.02	0.005	WD-XRF	Stork <i>et al.</i> 1987[40]
0.02	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
0.03	not reported	XRF	Couture <i>et al.</i> 1993[42]
0.051	not reported	ICP-AES	Cantagrel and Pin 1994[43]
0.049	0.005	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.03 (n=8) 0.01 0.02 66.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.03 (n=33)	0.02	Originally certified value	Steele and Hansen 1979[8]

\* Incomplete dissolution

**Table 11:** Summary of the published data for Ag in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<3*	not reported	ICP-AES	Church 1981[44]
9.45	not reported	HG-FAAS	Terashima 1986[48]
0.76	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
<2	not reported	INAA	Korotev 1996[45]
0.13 - 17		Median MADe Expanded uncertainty, k=2 Relative uncertainty, %  Range reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

**Table 12:** Summary of the published data for As in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<6*	not reported	ICP-AES	Church 1981[44]
0.4	not reported	HG-FAAS	Terashima 1986[48]
<DL	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
<1	not reported	INAA	Korotev 1996[45]
0.46		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

DL = detection limit

**Table 13:** Summary of the published data for Au in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<3*	not reported	ICP-AES	Church 1981[44]
0.76*	0.06	SE-FAAS (GTA)	Terashima 1988[49]
<6	not reported	INAA	Korotev 1996[45]
0.00065	0.000145	NiS Fire assay ICP-MS	Plessen and Erzinger 1998[50]
0.004		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 14:** Summary of the published data for B in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
2.7*	not reported	ICP-AES	Walsh 1985[51]
4.76	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
2.5 - 9		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 15:** Summary of the published data for Ba in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
90	7	IEC	Strelow et al. 1978[94]
200	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
80.3*	1.6	ICP-AES	Church 1981[44]
99	not reported	XRF	Robinson and Bennett 1981[86]
89.8	3.3	XRF	Verma et al. 1992[41]
83.75	not reported	ICP-AES	Cantagrel and Pin 1994[43]
90	5.2	IE-ICP-AES	Cantagrel and Pin 1994[43]
84	not reported	INAA	Korotev 1996[45]
89.9 (n=8) 8.9 17.8 19.8		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
102 (n=22) 82.9	21 1.1	Originally certified value ID-ICP-MS	Steele et al.1978[7] This work

\* Incomplete dissolution

**Table 16:** Summary of the published data for Be in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.27	0.02	IEC	Strelow et al. 1978[94]
0.43*	0.02	ICP-AES	Church 1981[44]
419*	43	SE-FAAS	Vilcsek and Lohmann 1982[54]
0.38	not reported	ICP-AES	Watkins and Thompson 1983[55]
1.04	0.82	SN-ICP-MS	Jarvis and Williams1989[47]
0.26 - 3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele et al. 1978[7]

\* Incomplete dissolution



**Table 17:** Summary of the published data for Bi in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.01	not reported	FD-FAAS	Heinrichs 1979[56]
<25*	not reported	ICP-AES	Church 1981[44]
11	not reported	SE-HG-FAAS	Terashima 1984[57]
<DL*	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Reported during certification	Steele <u>et al.</u> 1978[7]

\* Incomplete dissolution

DL = detection limit

**Table 18:** Summary of the published data for Cd in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.047		FD-FAAS	Heinrichs 1979[56]
<2*		ICP-AES	Church 1981[44]
<DL		SN-ICP-MS	Jarvis and Williams 1989[47]
1 – 4 0.0879	0.0032	Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification ID-IP-MS	Steele <u>et al.</u> 1978[7] This work

\* Incomplete dissolution

DL = detection limit

**Table 19:** Summary of the published data for Ce in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
10	3	IE-CES	Mazzucotelli and Vannucci 1980[59]
<15*	not reported	ICP-AES	Church 1981[44]
5.9	not reported	INAA	Potts <i>et al.</i> 1981[60]
<10	not reported	XRF	Robinson and Bennett 1981[86]
39	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
<12	not reported	XRF	Juras <i>et al.</i> 1987[107]
6.32	0.4	IE-ICP-AES	Jarvis and Jarvis 1988[62]
5.69	not reported	HPIC - light detector	Le Roex and Watkins 1990[108]
6.32	not reported	ICP-AES	Le Roex and Watkins 1990[108]
4.8	0.1	IE-ICP-AES	Roelandts 1990[63]
5.5	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
5	0.7	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
7.3	3	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
5.85	not reported	ICP-AES	Cantagrel and Pin 1994[43]
5.9	1.8	IE-ICP-AES	Cantagrel and Pin 1994[43]
5.74	0.02	IE-ICP-AES	Cantagrel and Pin 1994[43]
5.87	0.39	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
5.62	not reported	INAA	Korotev 1996[45]
5.8	0.03	IE-ICP-MS	Pin and Joannon 1997[109]
5.86 (n=19)		Median	
0.44		MADe	
0.88		Expanded uncertainty, k=2	
15.0		Relative expanded uncertainty, %	
6 (n=13)	3	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

**Table 20:** Summary of the published data for Cl in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
34	not reported	IE-CIC (LECO)	Evans and Moore 1980[100]
40 - 300		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele and Hansen 1979[8]

**Table 21:** Summary of the published data for Co in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
56.4*	1.7	ICP-AES	Church 1981[44]
59	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
51	not reported	XRF	Victor 1986[68]
59.5	0.1	IE-FAAS	Verma <i>et al.</i> 1992[41]
51	1.2	XRF	Korotev 1996[45]
59.2	not reported	INAA	
57.7 (n=6) 2.4 4.8 8.3		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
58 (n=34)	10	Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 22:** Summary of the published data for Cr in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
31.1*	1.6	ICP-AES	Church 1981[44]
28	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
37.5	2.5	WD-XRF	Verma <i>et al.</i> 1992[41]
42.05	not reported	ICP-AES	Cantagrel and Pin 1994[43]
32.8	3	IE-ICP-AES	Cantagrel and Pin 1994[43]
30	not reported	XRF	Class <i>et al.</i> 1994[110]
9	not reported	INAA	Korotev 1996[45]
31.1 (n=7) 4.6 9.2 29.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
30 (n=34)	8	Originally certified value (provisional)	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 23:** Summary of the published data for Cs in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.23	0.02	Flame emission	Goguel 1981[69]
0.22	not reported	Flame emission	Terashima and Mita 1981[70]
0.24	not reported	INAA	Korotev 1996[45]
0.23 (n=3) 0.01 0.02 8.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.2-4		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 24:** Summary of the published data for Cu in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
8*	1	ICP-AES	Church 1981[44]
15	not reported	XRF	Robinson and Bennett 1981[86]
13.22	0.09	IE-AAS	Victor 1983[71]
12	not reported	XRF	Webb <i>et al.</i> 1990[72]
12.5	1.1	XRF	Verma <i>et al.</i> 1992[41]
10.6	not reported	ICP-AES	Cantagrel and Pin 1994[43]
11	0.3	IE-ICP-AES	Cantagrel and Pin 1994[43]
12.0 (n=7)		Median	
1.8		MADe	
3.6		Expanded uncertainty,	
30.0		k=2	
		Relative expanded uncertainty, %	
14 (n=34)	4	Originally certified value	Steele <i>et al.</i> 1978[7]
10.67	0.23	ID-ICP-MS	This work

\* Incomplete dissolution

**Table 25:** Summary of the published data for Dy in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
1.1	not reported	INAA	Potts <i>et al.</i> 1981[60]
5	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
1.4	not reported	IE-GF-AAS (GTA)	Juras <i>et al.</i> 1987[107]
1	0.01	IE-ICP-AES	Jarvis and Jarvis 1988[62]
1.1	not reported	HPIC - light detector	Le Roex and Watkins 1990[108]
1	not reported	ICP-AES	Le Roex and Watkins 1990[108]
1.2	0.1	IE-ICP-AES	Roelandts 1990[63]
1.06	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
1.12	0.2	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
1.3	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
1.05	0.01	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.98	0.23	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
1.1	not reported	INAA	Korotev 1996[45]
1.06	0.007	IE-ICP-MS	Pin and Joannon 1997[109]
1.1 (n=14)		Median	
0.1		MADe	
0.2		expanded uncertainty, k=2	
18.2		Relative expanded uncertainty, %	
1.099-1.929		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 26:** Summary of the published data for Er in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.66	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.9	not reported	IE-FAAS (GTA)	Juras <i>et al.</i> 1987[107]
0.67	0.04	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.64	not reported	HPIC - light detector	Le Roex and Watkins 1990[108]
0.67	not reported	ICP-AES	Le Roex and Watkins 1990[108]
0.67	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
0.71	0.08	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.5	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.84	0.02	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.63	0.1	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.66	not reported	INAA	Korotev 1996[45]
0.655	0.007	IE-ICP-MS	Pin and Joannon 1997[109]
0.665 (n=12)		Median	
0.026		MADe	
0.052		Expanded uncertainty, k=2	
7.8		Relative expanded uncertainty, %	
		Originally certified value	Steele <i>et al.</i> 1978[7]

**Table 27:** Summary of the published data for Eu in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<0.6*	not reported	ICP-AES	Church 1981[44] Horsky and Fletcher 1981[102]
0.8	not reported	IE-GF-AAS	Potts <i>et al.</i> 1981[60]
0.59	not reported	INAA	Bolton <i>et al.</i> 1983[61]
1.9	not reported	IE-ICP-AES	Juras <i>et al.</i> 1987[107]
0.4	not reported	IE-FAAS (GTA)	Jarvis and Jarvis 1988[62]
0.57	0.01	IE-ICP-AES	Le Roex and Watkins 1990[108]
0.6	not reported	HPIC - light detector	Le Roex and Watkins 1990[108]
0.57	not reported	ICP-AES	Roelandts 1990[63]
0.65	0.01	IE-ICP-AES	Watkins and Nolan 1990[64]
0.58	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.52	0.15	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.5	0.2	IE-XRF	Cantagrel and Pin 1994[43]
0.6	0.02	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.62	0.05	IE-ICP-AES	Korotev 1996[45]
0.589	not reported	INAA	Pin and Joannon 1997[109]
0.58	0.002	IE-ICP-MS	
0.59 (n=15)		Median	
0.03		MADe	
0.06		Expanded uncertainty, k=2	
10.2		Relative expanded uncertainty, %	
0.63 (0.59-0.69) <sup>#</sup> (n=14)		Revised value	Hansen and Ring 1985[9]

<sup>#</sup> 95% confidence interval



**Table 28:** Summary of the published data for F in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
22	1	ISE	Troll and Farzaneh 1978[73]
59.4	5	INAA	Esprit <i>et al.</i> 1984[74]
35	not reported	PIGE	Roelandts <i>et al.</i> 1985[75]
10-530		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Range reported during certification	Steele and Hansen 1979[8]

**Table 29:** Summary of the published data for Ga in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
18	not reported	XRF	Robinson and Bennett 1981[86]
16.2	0.2	IE-FAAS	Van der Walt and Strelow 1984[76]
15	not reported	XRF	Webb <i>et al.</i> 1990[72]
16.2 (n=3) 1.8 3.6 22.2		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
16 (n=13)	3	Originally certified value	Steele <i>et al.</i> 1978[7]

**Table 30:** Summary of the published data for Gd in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<2*	not reported	ICP-AES	Church 1981[44]
0.99	not reported	INAA	Potts <i>et al.</i> 1981[60]
5	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
0.91	0.03	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.93	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
0.91	not reported	ICP-AES	Le Roex and Watkins 1990[108]
0.8	0.01	IE-ICP-AES	Roelandts 1990[63]
0.96	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
0.98	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.6	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.91	0.04	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.97	0.11	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.94	not reported	INAA	Korotev 1996[45]
1.01	0.03	IE-ICP-MS	Pin and Joannon 1997[109]
0.94 (n=13)		Median	
0.04		MADe	
0.08		Expanded uncertainty, k=2	
8.5		Relative expanded uncertainty, %	
0.12-0.74		Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 31:** Summary of the published data for Ge in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
1.67	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
1.54	0.03	SE-HG-ICP-AES	Halicz 1990[103]
		Median	
		MADe	
		Expanded uncertainty, k=2	
		Relative expanded uncertainty, %	
1.0-1.4		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 32:** Summary of the published data for Hf in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.38	not reported	INAA	Potts et al. 1981[60] Watkins and Nolan 1990[64]
0.1	not reported	IE-ICP-AES	
0.36	not reported	INAA	Korotev 1996[45]
0.36 (n=3) 0.03 0.06 16.7 0.2-5		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele et al. 1978[7]

**Table 33:** Summary of the published data for Hg in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
20.4	0.89	FAAS	Flanagan et al. 1982[77]
12.8*	0.63	HG-FAAS	Chan and Bina 1989[78]
54	3	CV-AAS	Terashima 1994[79]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele et al. 1978[7]

\* Incomplete dissolution

**Table 34:** Summary of the published data for Ho in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.23	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.22	not reported	IE-ICP-AES	Jarvis and Jarvis 1988[62] Watkins and Nolan 1990[64]
0.22	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.25	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.22	0.03	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.24	not reported	INAA	Korotev 1996[45]
0.227	0.002	IE-ICP-MS	Pin and Joannon 1997[109]
0.22 (n=6)		Median	
0.01		MADe	
0.02		Expanded uncertainty, k=2	
9.1		Relative expanded uncertainty, %	
0.22		Reported during certification	Steele <i>et al.</i> 1978[7]

**Table 35:** Summary of the published data for La in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<5*	not reported	ICP-AES	Church 1981[44]
2.6	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
<5	not reported	WD-XRF	
11	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
<3	not reported	XRF	Juras <i>et al.</i> 1987[107]
5	not reported	WD-XRF	Stork <i>et al.</i> 1987[40]
3.09	0.61	IE-ICP-AES	Jarvis and Jarvis 1988[62] Le Roex and Watkins 1990[108]
2.67	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
3.09	not reported	ICP-AES	
3.9	0.1	IE-ICP-AES	Roelandts 1990[63] Watkins and Nolan 1990[64]
2.8	not reported	IE-ICP-AES	
3.9	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
2.4	1	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
2.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
3.1	1.3	IE-ICP-AES	Cantagrel and Pin 1994[43]
3.65	0.55	IE-ICP-AES	Cantagrel and Pin 1994[43]
3.01	0.09	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
2.84	not reported	INAA	Korotev 1996[45]
2.87	0.02	IE-ICP-MS	Pin and Joannon 1997[109]
3.05 (n=16) 0.62 1.24 40.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
3 (n=11)	0.4	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

**Table 36:** Summary of the published data for Li in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
5.1	0.3	IEC	Strelow <i>et al.</i> 1978[94]
7.2	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
<2*	0.78	ICP-AES	Church 1981[44]
4-9		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 37:** Summary of the published data for Lu in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.11	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.11	not reported	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.11	0.01	IE-ICP-AES	Roelandts 1990[63]
0.1	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
0.17	0.05	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.3	0.1	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.09	0.01	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.17	0.03	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.101	not reported	INAA	Korotev 1996[45]
0.112	0.001	IE-ICP-MS	Pin and Joannon 1997[109]
0.11 (n=10) 0.01  0.02 18.2		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Revised value (provisional)	Hansen and Ring 1985[9]
0.2 (n=7)	0.1		

**Table 38:** Summary of the published data for Mo in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<4*	not reported	ICP-AES	Church 1981[44]
0.93	not reported	SE-ICP-AES	Thompson and Zao 1985[104]
<DL	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]
0.84-60 0.888	0.053	ID-ICP-MS	This work

\* Incomplete dissolution

DL = detection limit

**Table 39:** Summary of the published data for Nb in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
4	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
<2	not reported	WD-XRF	Robinson and Bennett 1981[86]
0.68	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.3	0.02	SSMS	Jochum <i>et al.</i> 1990[111]
0.3	0.02	XRF	Jochum <i>et al.</i> 1990[111]
2	not reported	XRF	Webb <i>et al.</i> 1990[72]
0.97	0.03	WD-XRF	Verma <i>et al.</i> 1992[41]
0.63	0.02	ICP-MS	Poitrasson <i>et al.</i> 1993[83]
0.36	0.01	IE-HPLC	Rèhkamper 1994[112]
0.27	not reported	WD-XRF	Etoubleau <i>et al.</i> 1999[113]
0.32	not reported	IE-WD-XRF	Etoubleau <i>et al.</i> 1999[113]
		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]
2-3			

**Table 40:** Summary of the published data for Nd in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<20*	not reported	ICP-AES	Church 1981[44]
3.2	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
<12	not reported	WD-XRF	Bolton <i>et al.</i> 1983[61]
<30	not reported	IE-ICP-AES	Juras <i>et al.</i> 1987[107]
8	not reported	XRF	Jarvis and Jarvis 1988[62]
3.32	0.25	IE-ICP-AES	Le Roex and Watkins 1990[108]
3.22	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
3.32	not reported	ICP-AES	Roelandts 1990[63]
3.1	0.1	IE-ICP-AES	Watkins and Nolan 1990[64]
3.9	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
3.1	0.3	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
2	0.6	IE-XRF	Cantagrel and Pin 1994[43]
3.03	0.09	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
2.97	0.21	IE-ICP-AES	Korotev 1996[45]
3.2	not reported	INAA	Pin and Joannon 1997[109]
3.18	0.01	IE-ICP-MS	
3.20 (n=13)		Median	
0.18		MADe	
0.36		Expanded uncertainty, k=2	
11.3		Relative expanded uncertainty, %	
3 (n=7)	2	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution



**Table 41:** Summary of the published data for Ni in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
101	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
117*	3.5	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
122	not reported	WD-XRF	Victor 1987[84]
122.9	0.3	IE-FAAS	Victor 1987[84]
117	not reported	XRF	Webb <i>et al.</i> 1990[72]
110	not reported	WD-XRF	Verma <i>et al.</i> 1992[41]
119.5	not reported	ICP-AES	Cantagrel and Pin 1994[43] Cantagrel and Pin 1994[43]
122	5	IE-ICP-AES	1994[43]
122	not reported	INAA	Korotev 1996[45]
119.5 (n=9)		Median	
3.7		MADe	
7.4		Expanded uncertainty, k=2	
6.2		Relative expanded uncertainty, %	
120 (n=44)	22	Originally certified value	Steele <i>et al.</i> 1978[7]
119.3	5.4	ID-ICP-MS	This work

\* Incomplete dissolution  
DL = detection limit

**Table 42:** Summary of the published data for Pb in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
2.48	0.05	IE-AAS	Victor and Strelow 1980[85]
<13*	not reported	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
21	not reported	WD-XRF	1981[86]
		Median	
		MADe	
		Expanded uncertainty, k=2	
		Relative expanded uncertainty, %	
0.8-26		Range reported during certification	Steele <i>et al.</i> 1978[7]
2.110	0.031	ID-ICP-MS	This work

\* Incomplete dissolution

**Table 43:** Summary of the published data for Pr in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
2.43	0.09	Flame emission	Goguel 1981[69]
0.74	not reported	INAA	Potts <i>et al.</i> 1981[60] Robinson and Bennett 1981[86]
<15	not reported	WD-XRF	1981[86]
0.77	0.04	IE-ICP-AES	Jarvis and Jarvis 1988[62] Le Roex and Watkins 1990[108]
0.75	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
0.77	not reported	ICP-AES	Watkins and Nolan 1990[64]
0.67	not reported	IE-ICP-AES	1990[64]
0.7	0.1	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.7	0.3	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.48	0.16	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.69	0.12	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.71	not reported	INAA	Korotev 1996[45]
0.73	0.005	IE-ICP-MS	Pin and Joannon 1997[109]
0.72 (n=12)		Median	
0.04		MADe	
0.08		Expanded uncertainty, k=2	
11.1		Relative expanded uncertainty, %	
0.72		Reported during certification	Steele <i>et al.</i> 1978[7]

**Table 44:** Summary of the published data for Rb in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
1	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
8.8	not reported	Grimm GDL	Bubert and Hagenah 1981[52]
7	not reported	WD-XRF	Robinson and Bennett 1981[86]
191.1	not reported	XRF	Galson <i>et al.</i> 1983[92]
5	not reported	XRF	Webb <i>et al.</i> 1990[72]
3.9	0.2	WD-XRF	Verma <i>et al.</i> 1992[41]
4.9	not reported	INAA	Korotev 1996[45]
2.4-18		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 45:** Summary of the published data for S in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
50	not reported	Combustion/Infrared photometry	Terashima 1978[106]
42-140		Median MADe Expanded uncertainty, k=2  Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 46:** Summary of the published data for Sb in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<18 <sup>*</sup>	not reported	ICP-AES	Church 1981[44]
0.05	not reported	HG-FAAS	Terashima 1986[48]
<DL	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.06	not reported	INAA	Korotev 1996[45]
0.07-0.49		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Originally certified value	Steele et al. 1978[7]

<sup>\*</sup> Incomplete dissolution

DL = detection limit

**Table 47:** Summary of the published data for Sc in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
36	not reported	IE-ICP-AES	Bolton et al. 1983[61]
37.4	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
38.7	not reported	ICP-AES	Cantagrel and Pin 1994[43]
39.4	2.1	IE-ICP-AES	Cantagrel and Pin 1994[43]
39.8	not reported	INAA	Korotev 1996[45]
38.7 (n=5) 1.6 3.2 8.3  31-130		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele et al. 1978[7]

**Table 48:** Summary of the published data for Sm in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<5*	not reported	ICP-AES	Church 1981[44]
<1	not reported	IE-GF-AAS	Horsky and Fletcher 1981[102]
0.91	not reported	INAA	Potts <u>et al.</u> 1981[60]
<10	not reported	WD-XRF	Robinson and Bennett 1981[86]
<15	not reported	IE-ICP-AES	Bolton <u>et al.</u> 1983[61]
1.5	not reported	IE-GF-AAS (GTA)	Juras <u>et al.</u> 1987[107]
0.78	0.06	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.85	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
0.78	not reported	ICP-AES	Le Roex and Watkins 1990[108]
0.88	0.01	IE-ICP-AES	Roelandts 1990[63]
0.82	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
<1.2	not reported	IE-ICP-AES	Bauer-Wolf <u>et al.</u> 1993[65]
0.8	0.2	IE-XRF	Bauer-Wolf <u>et al.</u> 1993[65]
0.77	0.01	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.84	0.09	IE-ICP-AES	Fariñas <u>et al.</u> 1995[98]
0.837	not reported	INAA	Korotev 1996[45]
0.807	0.004	IE-ICP-MS	Pin and Joannon 1997[109]
0.83 (n=12)		Median	
0.04		MADe	
0.08		Expanded uncertainty,	
9.6		k=2	
		Relative expanded uncertainty, %	
0.8 (n=9)	0.2	Revised value (provisional)	Hansen and Ring 1985[9]

\* Incomplete dissolution

**Table 49:** Summary of the published data for Sn in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<3*	not reported	ICP-AES	Church 1981[44]
0.27	not reported	SE-AAS	Terashima 1982[87]
0.28	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.23	not reported	SSMS	Jochum <i>et al.</i> 1993[114]
0.3-5		Median MADe  Expanded uncertainty, k=2 Relative expanded uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 50:** Summary of the published data for Sr in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
264	1	IEC	Strelow <i>et al.</i> 1978[94]
256	not reported	XRF	Vié le Sage <i>et al.</i> 1979[82]
253*	5.1	ICP-AES	Church 1981[44]
268	not reported	WD-XRF	Robinson and Bennett 1981[86]
266	not reported	XRF	Webb <i>et al.</i> 1990[72]
264.6	1.2	WD-XRF	Verma <i>et al.</i> 1992[41]
250	not reported	ICP-AES	Cantagrel and Pin 1994[43]
251	6.8	IE-ICP-AES	Cantagrel and Pin 1994[43]
269	not reported	INAA	Korotev 1996[45]
264 (n=9) 7 14 5.3		Median MADe  Expanded uncertainty, k=2 Relative expanded uncertainty, %	
260 (n=34) 260.9	39 4.6	Originally certified value ID-ICP-MS	Steele <i>et al.</i> 1978[7] This work

\* Incomplete dissolution

**Table 51:** Summary of the published data for Ta in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.07	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.09	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.16	not reported	ICP-MS	Poitrasson <i>et al.</i> 1993[83]
0.064	not reported	INAA	Korotev 1996[45]
0.08 (n=4) 0.02 0.04 50.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.06-0.4		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 52:** Summary of the published data for Tb in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.17	not reported	INAA	Potts <i>et al.</i> 1981[60]
0.15	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
<0.19	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.16	0.02	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.164	not reported	INAA	Korotev 1996[45]
0.162	0.0004	IE-ICP-MS	Pin and Joannon 1997[109]
0.162 (n=5) 0.003 0.006 3.7		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.1-0.16		Range reported during certification	Steele <i>et al.</i> 1978[7]

**Table 53:** Summary of the published data for Th in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<25*	not reported	ICP-AES	Church 1981[44]
0.42	not reported	INAA	Potts <i>et al.</i> 1981[60]
<3	not reported	XRF	Robinson and Bennett 1981[86]
3.6	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.34	not reported	INAA	Korotev 1996[45]
0.42 (n=3) 0.12 0.24 57.1		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.2-5		Range reported during original certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 54:** Summary of the published data for Tm in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.1	not reported	INAA	Potts <i>et al.</i> 1981[60]
<0.5	not reported	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
<0.2	not reported	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.1	0.01	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.099	not reported	INAA	Korotev 1996[45]
0.106	0.001	IE-ICP-MS	Pin and Joannon 1997[109]
0.100 (n=4) 0.001 0.002 2.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.1		Reported during certification	Steele <i>et al.</i> 1978[7]



**Table 55:** Summary of the published data for U in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.4	0.1	IEC	Strelow <i>et al.</i> 1978[94]
<20*	not reported	ICP-AES	Church 1981[44]
<2	not reported	WD-XRF	Robinson and Bennett 1981[86]
0.32	not reported	DNC	Massey 1983[115]
0.28	0.03	IE-Fluorimetry	Kanai <i>et al.</i> 1986[89]
0.93	not reported	SN-ICP-MS	Jarvis and Williams 1989[47]
0.4	not reported	INAA	Korotev 1996[45]
0.4 (n=5) 0.1 0.2 50.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.26-5		Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 56:** Summary of the published data for V in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
217	2.2	IEC	Strelow <i>et al.</i> 1978[94]
225*	6.8	ICP-AES	Church 1981[44]
201.3	1.3	WD-XRF	Verma <i>et al.</i> 1992[41]
209.5	not reported	ICP-AES	Cantagrel and Pin 1994[43]
215	1	IE-ICP-AES	Cantagrel and Pin 1994[43]
215 (n=5) 8 16 7.4		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
220 (n=31)	37	Originally certified value	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 57:** Summary of the published data for W in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
<7*	not reported	ICP-AES	Church 1981[44] Jarvis and Williams 1989[47]
<DL	0.19	SN-ICP-MS	1989[47]
<2	not reported	INAA	Korotev 1996[45]
10-400		Median MADe Uncertainty, k=2 Relative uncertainty, %  Range reported during certification	Steele <i>et al.</i> 1978[7]

\* Incomplete dissolution

**Table 58:** Summary of the published data for Y in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
5	not reported	WD-XRF	Robinson and Bennett 1981[86]
6	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61] Jarvis and Jarvis 1988[62]
5.67	0.16	IE-ICP-AES	Watkins and Nolan 1990[64]
5.5	not reported	IE-ICP-AES	1990[64]
8	not reported	XRF	Webb <i>et al.</i> 1990[72]
7.3	0.2	WD-XRF	Verma <i>et al.</i> 1992[41]
6.47	not reported	ICP-AES	Cantagrel and Pin 1994[43]
6.68	0.41	IE-ICP-AES	Cantagrel and Pin 1994[43]
5.89	0.18	IE-ICP-AES	Cantagrel and Pin 1994[43]
6.5	not reported	INAA	Korotev 1996[45]
6.2 (n=10) 0.7 1.4 22.6		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
6 (n=13)	3	Originally certified value	Steele <i>et al.</i> 1978[7] Hansen and Ring 1985[9]
7 (n=14)	3	Revised value (provisional)	1985[9]

**Table 59:** Summary of the published data for Yb in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
0.97 <sup>*</sup>	0.05	ICP-AES	Church 1981[44]
0.95	not reported	IE-GF-AAS	Horsky and Fletcher 1981[102]
1.1	not reported	IE-GF-AAS	Horsky and Fletcher 1981[102]
0.67 <sup>∞</sup>	not reported	INAA	Potts <i>et al.</i> 1981[60]
2	not reported	IE-ICP-AES	Bolton <i>et al.</i> 1983[61]
0.7	not reported	IE-FAAS (GTA)	Juras <i>et al.</i> 1987[107]
0.65	0.02	IE-ICP-AES	Jarvis and Jarvis 1988[62]
0.68	not reported	HPIC-light detector	Le Roex and Watkins 1990[108]
0.65	not reported	ICP-AES	Le Roex and Watkins 1990[108]
0.66	0.04	IE-ICP-AES	Roelandts 1990[63]
2.6	not reported	IE-ICP-AES	Watkins and Nolan 1990[64]
0.71	0.06	IE-ICP-AES	Bauer-Wolf <i>et al.</i> 1993[65]
0.6	0.2	IE-XRF	Bauer-Wolf <i>et al.</i> 1993[65]
0.7	0.006	IE-ICP-AES	Cantagrel and Pin 1994[43]
0.79	0.13	IE-ICP-AES	Fariñas <i>et al.</i> 1995[98]
0.657 <sup>∞</sup>	not reported	INAA	Korotev 1996[45]
0.688	0.008	IE-ICP-MS	Pin and Joannon 1997[109]
0.70 (n=17) 0.07 0.14 20.0		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
0.7 (n=10)	0.5	Revised value (provisional)	Hansen and Ring 1985[9]

<sup>\*</sup> Incomplete dissolution

<sup>∞</sup> Primary method

**Table 60:** Summary of the published data for Zn in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
54	not reported	WD-XRF	Vié le Sage et al. 1979[82]
65.9	0.2	IE-AAS	Victor and Strelow 1980[85]
61.9*	3.1	ICP-AES	Church 1981[44]
62	not reported	WD-XRF	Robinson and Bennett 1981[86]
63	not reported	XRF	Webb et al. 1990[72]
63.5	1.1	WD-XRF	Verma et al. 1992[41]
64.05	not reported	ICP-AES	Cantagrel and Pin 1994[43]
61.4	2.9	IE-ICP-AES	Cantagrel and Pin 1994[43]
62.5 (n=8)		Median	
1.6		MADe	
3.2		Expanded uncertainty, k=2	
5.1		Relative expanded uncertainty, %	
68 (n=29)	19	Originally certified value	Steele et al. 1978[7]
61.42	0.91	ID-ICP-MS	This work

\* Incomplete dissolution

**Table 61:** Summary of the published data for Zr in SARM 4

Published values	Standard deviation	Analysis technique	Reference
$\mu\text{g}\cdot\text{g}^{-1}$	$\mu\text{g}\cdot\text{g}^{-1}$		
ND	not reported	WD-XRF	Vié le Sage <i>et al.</i> 1979[82]
17*	1	ICP-AES	Church 1981[44] Robinson and Bennett 1981[86]
23	not reported	WD-XRF	Watkins and Thompson 1983[55]
20	not reported	ICP-AES	Jochum <i>et al.</i> 1990[111]
10.5	0.5	SSMS	Jochum <i>et al.</i> 1990[111]
10.5	0.5	XRF	Webb <i>et al.</i> 1990[72]
23	not reported	XRF	Verma <i>et al.</i> 1992[41]
13.6	0.1	WD-XRF	Cantagrel and Pin 1994[43]
25.7	not reported	ICP-AES	Cantagrel and Pin 1994[43]
11	3	IE-ICP-AES	Cantagrel and Pin 1994[43]
<80	not reported	INAA	Korotev 1996[45]
		Median MADe Expanded uncertainty, k=2 Relative expanded uncertainty, %	
23 (n=11)	12	Originally certified value (provisional)	Steele <i>et al.</i> 1978[7]

ND = not detected

\* Incomplete dissolution

## Appendix E

### Isotopic composition of the isotope enriched standards used for the HR-ICP-MS analysis

<sup>135</sup> Ba standard	Abundance, %	Specification	Standard uncertainty
<sup>130</sup> Ba	<0.010		
<sup>132</sup> Ba	0.057	0.00	0.000000
<sup>134</sup> Ba	0.466	0.00	0.000000
<sup>135</sup> Ba	93.380	0.02	0.011547005
<sup>136</sup> Ba	1.640	0.01	0.005773503
<sup>137</sup> Ba	0.890	0.01	0.005773503
<sup>138</sup> Ba	3.560	0.02	0.011547005

<sup>86</sup> Sr standard	Abundance, %	Specification	Standard uncertainty
<sup>84</sup> Sr	0.08	0.01	0.005773503
<sup>86</sup> Sr	97.02	0.04	0.023094011
<sup>87</sup> Sr	0.78	0.01	0.005773503
<sup>88</sup> Sr	2.12	0.03	0.017320508

<sup>67</sup> Zn standard	Abundance, %	Specification	Standard uncertainty
<sup>64</sup> Zn	1.113	0.00	0.000000
<sup>66</sup> Zn	1.95	0.02	0.011547005
<sup>67</sup> Zn	94.6	0.03	0.017320508
<sup>68</sup> Zn	2.28	0.01	0.005773503
<sup>70</sup> Zn	0.054	0.00	0.000000

<sup>65</sup> Cu standard	Abundance, %	Specification	Standard uncertainty
<sup>63</sup> Cu	0.39	0.02	0.011547005
<sup>65</sup> Cu	99.61	0.02	0.011547005

<sup>61</sup> Ni standard	Abundance, %	Specification	Standard uncertainty
<sup>58</sup> Ni	3.45	0.04	0.023094011
<sup>60</sup> Ni	6.12	0.06	0.034641016
<sup>61</sup> Ni	88.84	0.1	0.057735027
<sup>62</sup> Ni	1.40	0.01	0.005773503
<sup>64</sup> Ni	0.20	0.01	0.005773503

<sup>97</sup> Mo standard	Abundance, %	Specification	Standard uncertainty
<sup>92</sup> Mo	0.22		0.05
<sup>94</sup> Mo	0.24		0.05
<sup>95</sup> Mo	0.59		0.05
<sup>96</sup> Mo	1.34		0.05
<sup>97</sup> Mo	94.25		0.10
<sup>98</sup> Mo	3.07		0.10
<sup>100</sup> Mo	0.30		0.05

<sup>111</sup> Cd standard	Abundance, %	Specification	Standard uncertainty
<sup>106</sup> Cd	<0.005		0
<sup>108</sup> Cd	<0.005		0
<sup>110</sup> Cd	0.4250	0.0400	0.023094011
<sup>111</sup> Cd	95.7400	0.0420	0.024248711
<sup>112</sup> Cd	2.0809	0.0094	0.005427093
<sup>113</sup> Cd	0.5570	0.0054	0.003117691
<sup>114</sup> Cd	1.0411	0.0084	0.004849742
<sup>116</sup> Cd	0.1560	0.0042	0.002424871

<sup>206</sup> Pb standard	Abundance, %	Standard deviation	Standard uncertainty
<sup>204</sup> Pb	0.032	0.0032	0.0032
<sup>206</sup> Pb	98.41	0.01	0.01
<sup>207</sup> Pb	0.548	0.0033	0.0033
<sup>208</sup> Pb	1.00	0.008	0.008

# Appendix F

## Sequence of HR-ICP-MS sample analysis

Wash-1

Standard-1

Wash-2

Reagent-blank-1

Reagent-blank-2

Wash-3

Standard-2

Wash-4

Primary standard-1

Primary standard-2

Wash-5

Standard-3

Wash-6

Sample-1

Sample-2

Wash-7

Standard-4

Wash-8

Reagent-blank + spike-1

Reagent-blank + spike-2

Wash-9

Standard-5



Wash-10

Primary standard + spike-1

Primary standard + + spike-2

Wash-11

Standard-6

Wash-12

Sample + spike-1

Sample + spike-2

Wash-13

Standard-7

Wash-14

# Appendix G

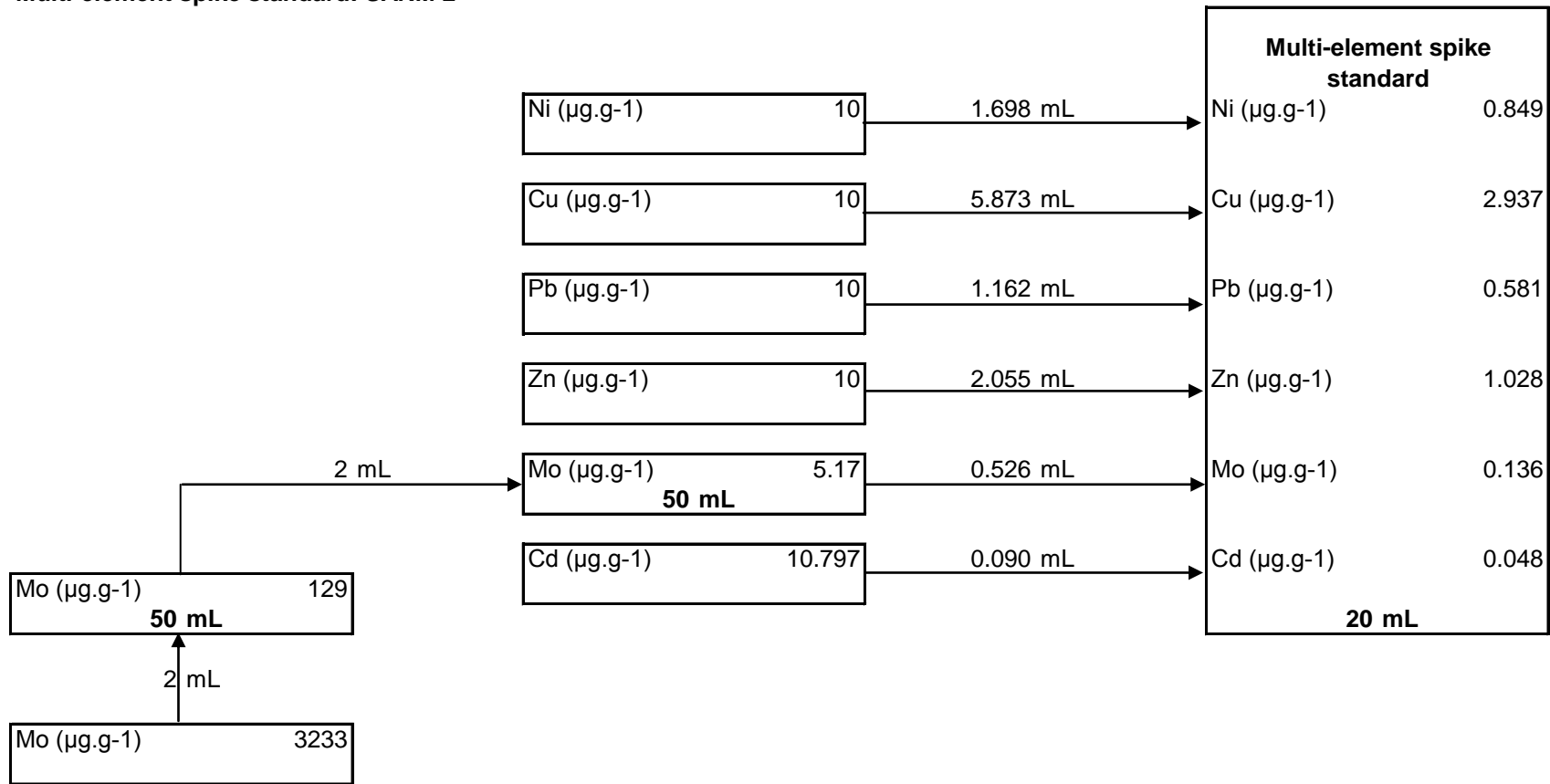
## Experimental designs

SARM 2

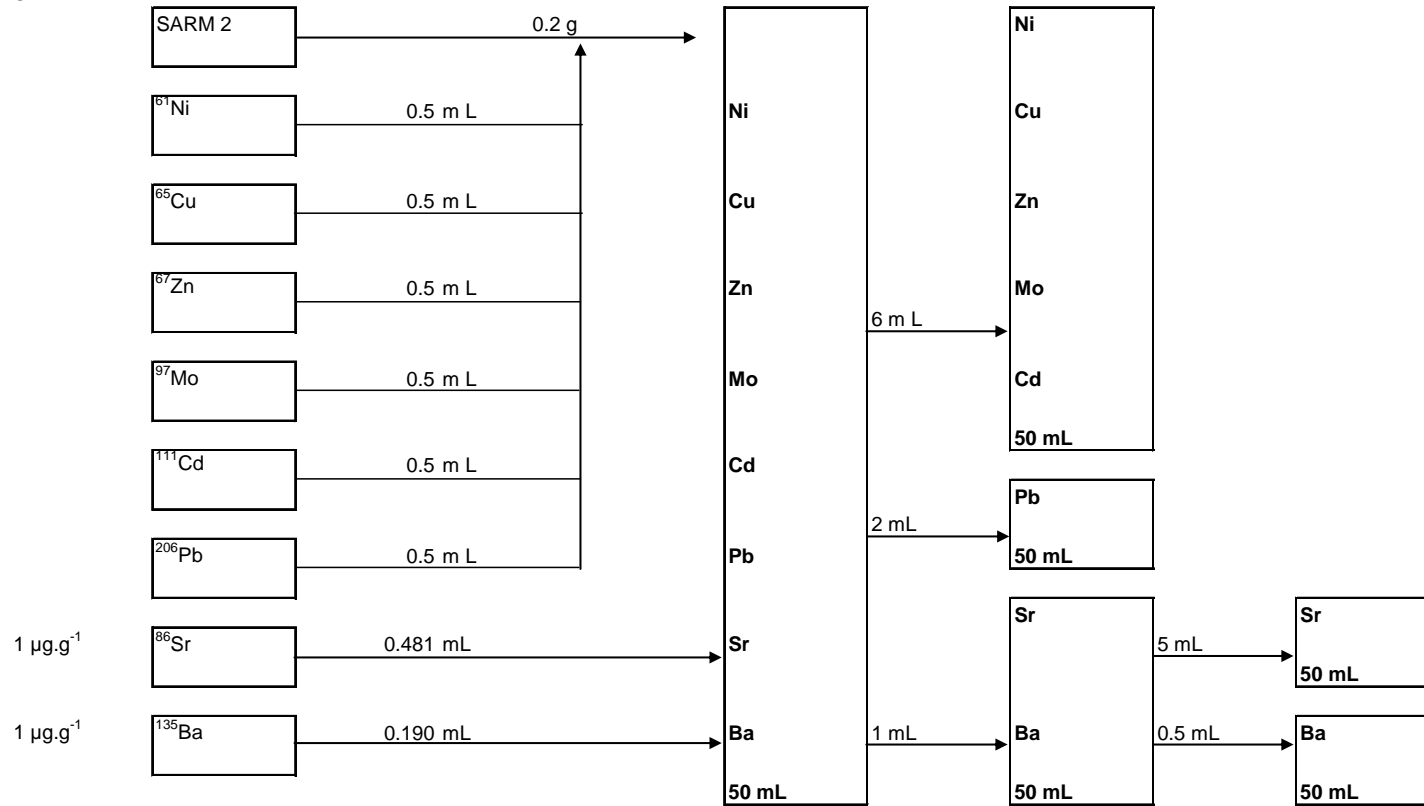
Elements	Expected concentration in SARM 2 $\mu\text{g.g}^{-1}$	Solid sample aliquot g	Amount of analyte in solid sample $\mu\text{g}$	Ratio	Required spike isotope addition for optimum ratio prior to digestion		Required multi-element spike standard concentration, $\mu\text{g.g}^{-1}$	(Required) Spike stock standard concentration $\mu\text{g.g}^{-1}$	Source spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Intermediate spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Amount of spike standard addition mL	Volume of spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$
					$\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Aliquot $\mu\text{g}$																
Ni	7	0.2	1.4	60Ni/61Ni	3.298245614	0.424	0.5	0.849	10		20				1.698	20	50	6	50			4.4
Cu	19	0.2	3.8	63Cu/65Cu	2.587897757	1.468	0.5	2.937	10		20				5.873	20	50	6	50			12.6
Pb	5	0.2	1	208Pb/206Pb	3.44204947	0.291	0.5	0.581	10		20				1.162	20	50	2	50			1.0
Zn	10	0.2	2	66Zn/67Zn	3.892857143	0.514	0.5	1.028	10		20				2.055	20	50	6	50			6.0
137Ba	2400	0.2	480	137Ba/135Ba	19.94178525	24.070			1		20				0.481	20	50	1	50	0.5	50	2.0
Mo	5	0.2	1	95Mo/97Mo	14.7032967	0.068	0.5	0.136	5.173333333	3233.333333	2	50	129.3333333	2	50	20	50	6	50			2.6
Cd	1	0.2	0.2	112Cd/111Cd	8.26646955	0.024	0.5	0.048	10.797		20				0.090	20	50	6	50			0.5
88Sr	62	0.2	12.4	88Sr/86Sr	1.305005501	9.502			1		20				0.190	20	50	1	50	5	50	0.9



Multi-element spike standard: SARM 2



SARM 2



Reference isotope	Spike isotope
<sup>60</sup> Ni	<sup>61</sup> Ni
<sup>63</sup> Cu	<sup>65</sup> Cu
<sup>208</sup> Pb	<sup>206</sup> Pb
<sup>66</sup> Zn	<sup>67</sup> Zn
<sup>137</sup> Ba	<sup>135</sup> Ba
<sup>95</sup> Mo	<sup>97</sup> Mo
<sup>112</sup> Cd	<sup>111</sup> Cd
<sup>88</sup> Sr	<sup>86</sup> Sr

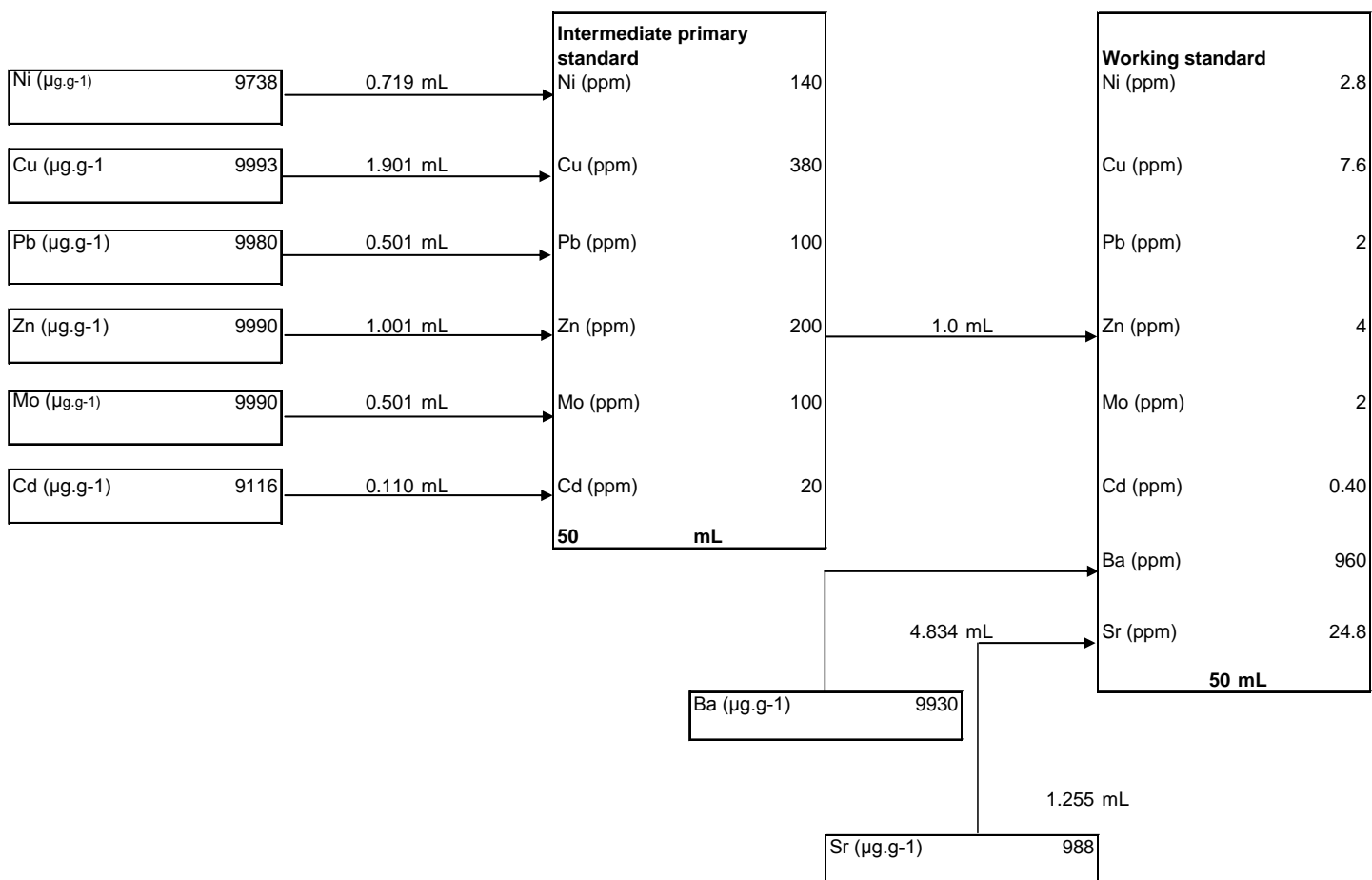


Single element standard: SARM 2

Elements	Amount of element required to match sample		Required concentration of each analyte in the final primary standard (working standard) $\mu\text{g.g}^{-1}$	Source primary standard concentration $\mu\text{g.g}^{-1}$	Uncertainty of source primary standard concentration (k=2) $\mu\text{g.g}^{-1}$		Amount of source primary standard added to IMPS $\mu\text{g.g}^{-1}$	Volume of primary standard added to IMPS $\mu\text{g.g}^{-1}$	Volume of intermediate primary standard $\mu\text{g.g}^{-1}$	Required concentration of intermediate primary standard $\mu\text{g.g}^{-1}$	Amount of IMPS to be added to working standard $\mu\text{g.g}^{-1}$	Volume of working standard $\mu\text{g.g}^{-1}$	Ratio $\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Required spike isotope addition for optimum ratio prior to digestion $\mu\text{g}$	Required multielement spike standard concentration, for 0.5 ml $\mu\text{g.g}^{-1}$	Spike stock standard concentration $\mu\text{g.g}^{-1}$	Amount of spike standard addition to 10 multielement spike standard $\mu\text{g.g}^{-1}$	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3 ml	Expected working sample concentration $\text{ng.ml}^{-1}$
	$\mu\text{g}$	mL																					
Ni	1.4	0.5	2.8	9 738	22	0.718833436	50	140	1.0	50	60Ni/61Ni	3.298245614	0.424	0.849	10	0.849	50						28
Cu	3.8	0.5	7.6	9993	16	1.901330932	50	380	1.0	50	63Cu/65Cu	2.587897757	1.468	2.937	10	2.937	50	10	50				15.2
Pb	1	0.5	2	9980	30	0.501002004	50	100	1.0	50	208Pb/206Pb	3.44204947	0.291	0.581	10	0.581	50	3	50				1.2
Zn	2	0.5	4	9990	20	1.001001001	50	200	1.0	50	66Zn/67Zn	3.892857143	0.514	1.028	10	1.028	50						40
Ba	480	0.5	960	9930	30					50	137Ba/135Ba	19.94178525	24.070	48.140	10	48.140	50	1	50	1	50		3.84
Mo	1	0.5	2	9990	30	0.500500501	50	100	1.0	50	95Mo/97Mo	14.7032967	0.068	0.136	10	0.136	50	5	50				2
Cd	0.2	0.5	0.40	9116	25	0.109697236	50	20	1.0	50	112Cd/111Cd	8.26646955	0.024	0.048	10	0.048	50	5	50				0.4
Sr	12.4	0.5	24.8	988	3					50	88Sr/86Sr	1.305005501	9.502	19.004	10	19.004	50	5	50	5	50		2.48



Single element primary standard: SARM 2

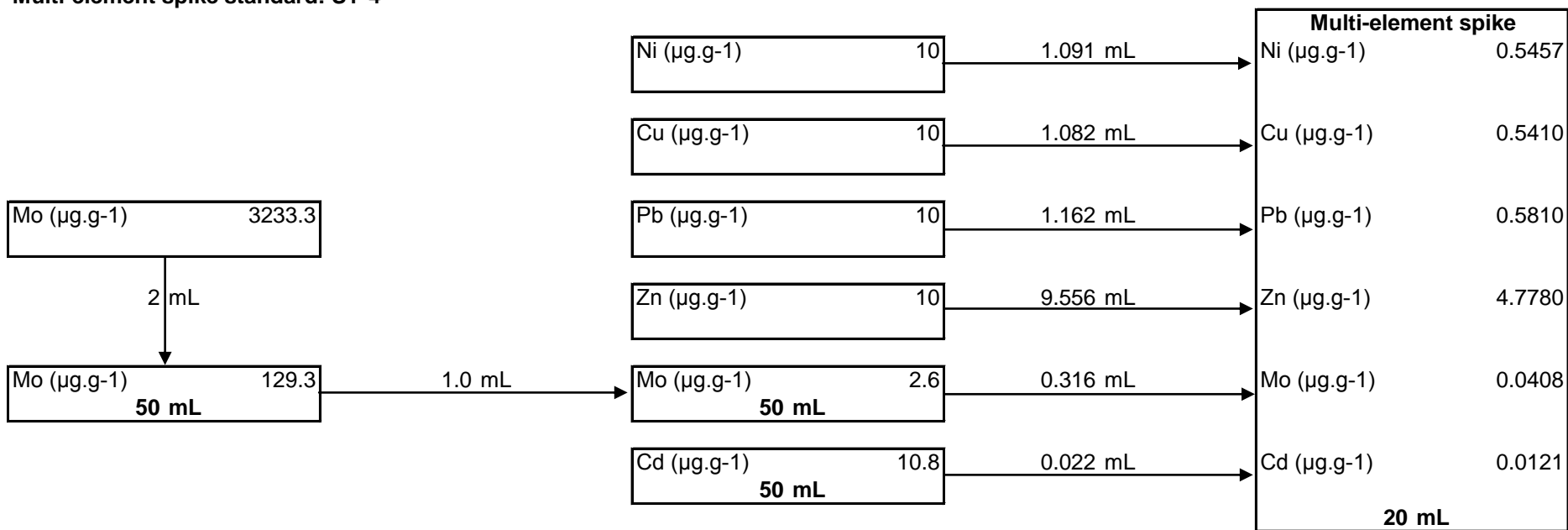


Reference isotope	Spike isotope
<sup>60</sup> Ni	<sup>61</sup> Ni
<sup>63</sup> Cu	<sup>65</sup> Cu
<sup>208</sup> Pb	<sup>206</sup> Pb
<sup>66</sup> Zn	<sup>67</sup> Zn
<sup>137</sup> Ba	<sup>135</sup> Ba
<sup>95</sup> Mo	<sup>97</sup> Mo
<sup>112</sup> Cd	<sup>111</sup> Cd
<sup>88</sup> Sr	<sup>86</sup> Sr

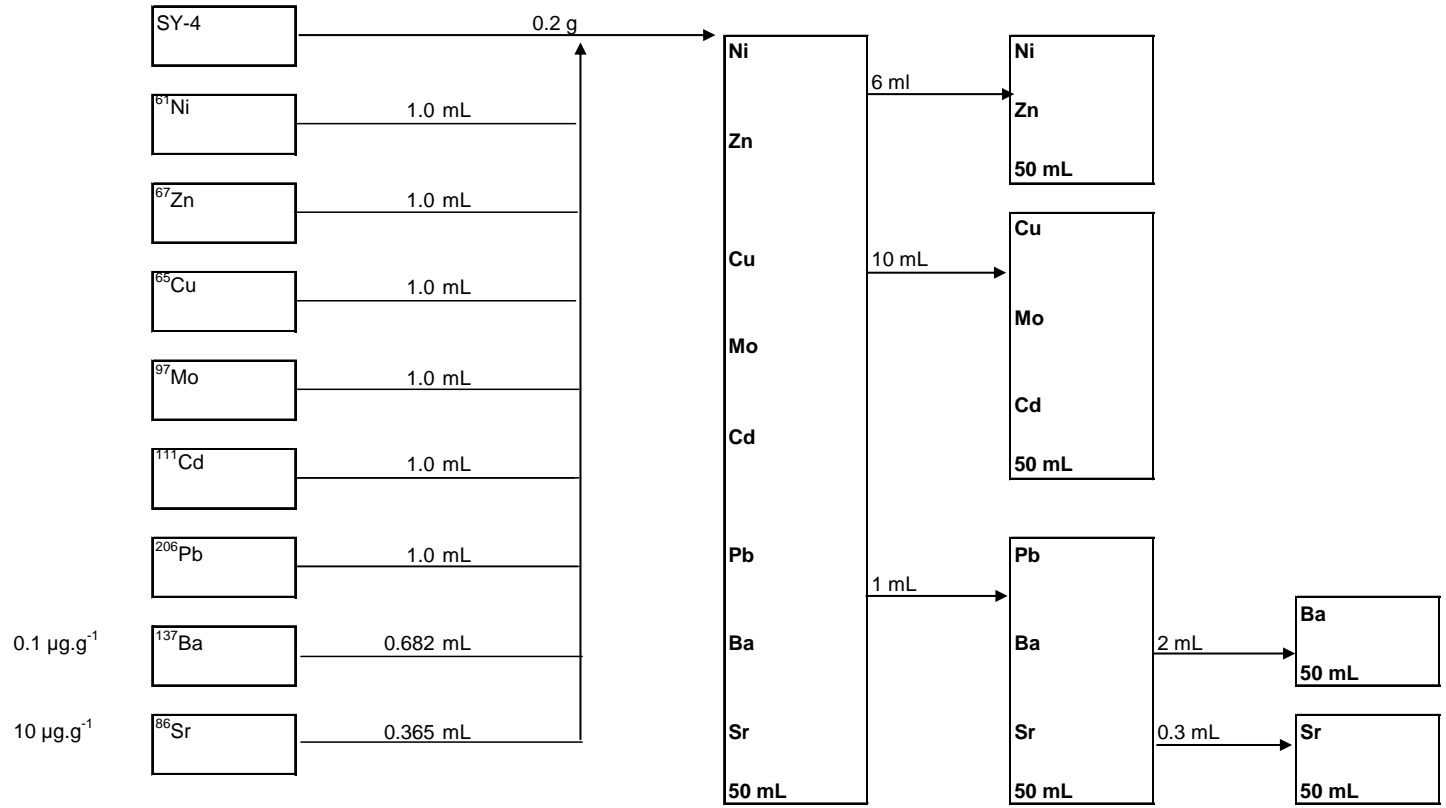
SY 4

Elements	Expected concentration in SY 4 $\mu\text{g.g}^{-1}$	Solid sample aliquot g	Amount of analyte in solid sample $\mu\text{g}$	Ratio	$\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Required spike isotope addition for optimum ratio prior to digestion		Required multielement spike standard concentration, $\mu\text{g.g}^{-1}$	Spike stock standard concentration $\mu\text{g.g}^{-1}$	Source spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Intermediate spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Amount of spike standard addition mL	Volume of spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$	
						$\mu\text{g}$	mL																	
Ni	9	0.2	1.8	60Ni/61Ni	3.298245614	0.5457	1.0	0.5457	10								1.091	20	50	6	50		5.6	
Cu	7	0.2	1.4	63Cu/65Cu	2.587897757	0.5410	1.0	0.5410	10								1.082	20	50	10	50		7.8	
Pb	10	0.2	2	208Pb/206Pb	3.44204947	0.5810	1.0	0.5810	10								1.162	20	50	1	50		1.0	
Zn	93	0.2	18.6	66Zn/67Zn	3.892857143	4.7780	1.0	4.7780	10								9.556	20	50	6	50		56.1	
<sup>137</sup> Ba	340	0.2	68	137Ba/135Ba	19.94178525	3.4099			0.1								0.682		50	1	50	2	50	1.1
Mo	3	0.2	0.6	95Mo/97Mo	14.7032967	0.0408	1.0	0.0408	2.586666667	3233.333333	2	50	129.3333333	1	50		0.316	20	50	10	50		2.6	
Cd	0.5	0.2	0.1	112Cd/111Cd	8.26646955	0.0121	1.0	0.0121	10.797								0.022	20	50	10	50		0.4	
<sup>88</sup> Sr	1191	0.2	238.2	88Sr/86Sr	1.305005501	182.5280			10								0.365		50	1	50	0.3	50	1.0

## Multi-element spike standard: SY-4



SY-4



Reference isotope	Spike isotope
$^{60}\text{Ni}$	$^{61}\text{Ni}$
$^{63}\text{Cu}$	$^{65}\text{Cu}$
$^{208}\text{Pb}$	$^{206}\text{Pb}$
$^{66}\text{Zn}$	$^{65}\text{Zn}$
$^{135}\text{Ba}$	$^{137}\text{Ba}$
$^{95}\text{Mo}$	$^{97}\text{Mo}$
$^{112}\text{Cd}$	$^{111}\text{Cd}$
$^{88}\text{Sr}$	$^{86}\text{Sr}$



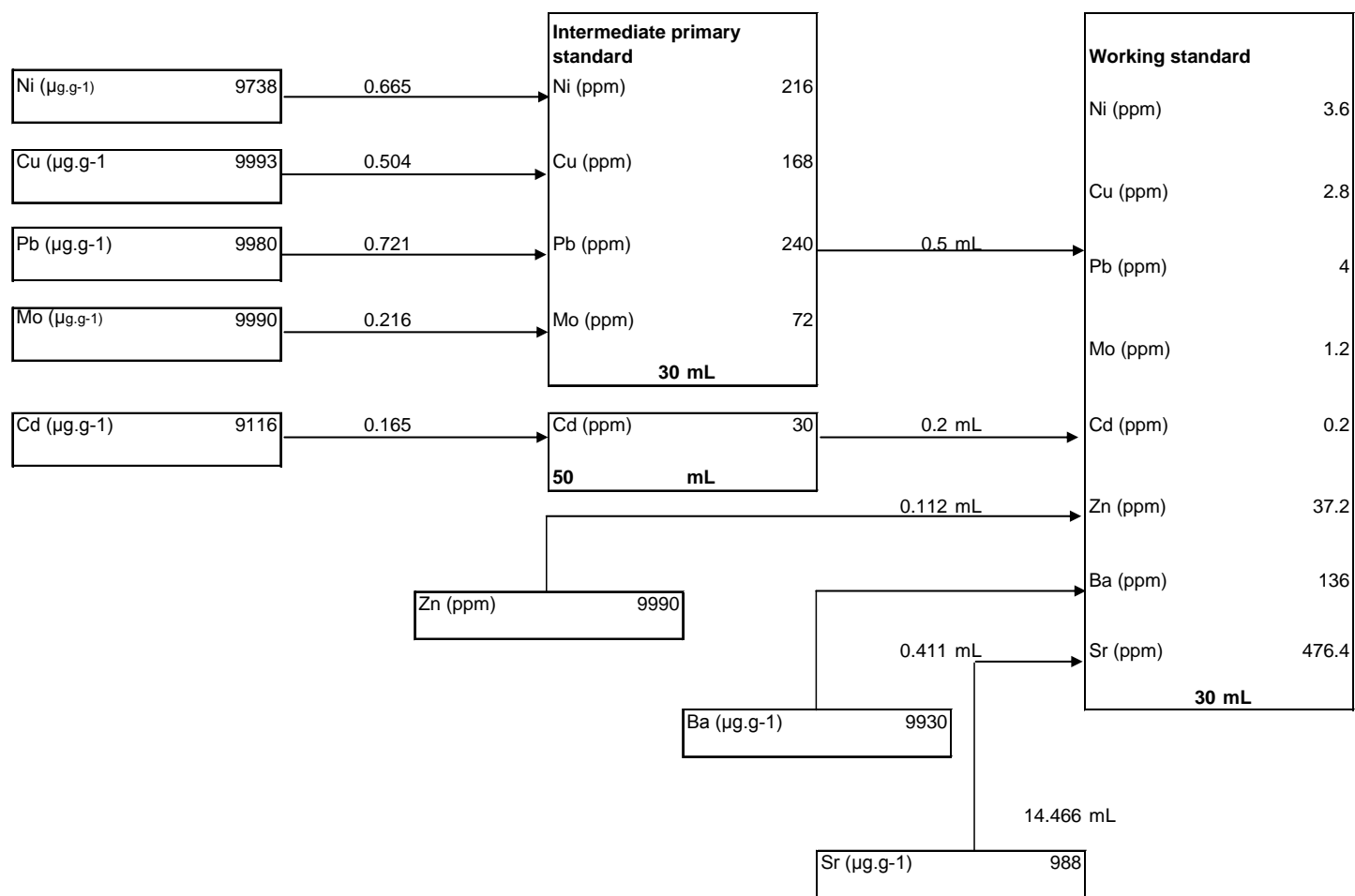


Single element standard: SY-4

Elements	Amount of element required to match sample		Required concentration of each analyte in the final primary standard (working standard) $\mu\text{g.g}^{-1}$	Source primary standard concentration $\mu\text{g.g}^{-1}$	Uncertainty of source primary standard concentration (k=2) $\mu\text{g.g}^{-1}$		Amount of source primary standard added to IMPS mL	Volume of primary standard mL	Required concentration of intermediate primary standard $\mu\text{g.g}^{-1}$	Amount of IMPS to be added to working standard mL	Volume of working standard mL	Ratio $\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Required spike isotope addition for optimum ratio prior to digestion $\mu\text{g}$	Required multielement spike standard concentration, for 0.5 ml $\mu\text{g.g}^{-1}$	Spike stock standard concentration $\mu\text{g.g}^{-1}$	Amount of spike standard addition to 10 multielement spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$
	$\mu\text{g}$	Aliquot mL																				
Ni	1.8	0.5	3.6	9 738	22	0.665	30	216	0.5	30	60Ni/61Ni	3.298245614	0.546	1.091	10	1.091	50					36
Cu	1.4	0.5	2.8	9993	16	0.504	30	168	0.5	30	63Cu/65Cu	2.587897757	0.541	1.082	10	1.082	50					28
Pb	2	0.5	4	9980	30	0.721	30	240	0.5	30	208Pb/206Pb	3.44204947	0.581	1.162	10	1.162	50	2	50			1.6
Zn	18.6	0.5	37.2	9990	20			0.112		30	66Zn/67Zn	3.892857143	4.778	9.556	10	9.556	50	10	50			74.4
Ba	68	0.5	136	9930	30			0.411		30	137Ba/135Ba	19.94178525	3.410	6.820	10	6.820	50	2	50	2	50	2.176
Mo	0.6	0.5	1.2	9990	30	0.216	30	72	0.5	30	95Mo/97Mo	14.7032967	0.041	0.082	10	0.082	50	10	50			2.4
Cd	0.1	0.5	0.2	9116	25	0.165	50	30	0.2	30	112Cd/111Cd	8.26646955	0.012	0.024	10	0.024	50	20	50			0.8
Sr	238.2	0.5	476.4	988	3			14.466		30	87Sr/86Sr	-33.65034965	-7.079	-14.157	10	-14.157	50	0.2	50	5	50	1.9056



Single element primary standard: SY-4



Reference isotope	Spike isotope
<sup>60</sup> Ni	<sup>61</sup> Ni
<sup>63</sup> Cu	<sup>65</sup> Cu
<sup>208</sup> Pb	<sup>206</sup> Pb
<sup>66</sup> Zn	<sup>67</sup> Zn
<sup>137</sup> Ba	<sup>135</sup> Ba
<sup>95</sup> Mo	<sup>97</sup> Mo
<sup>112</sup> Cd	<sup>111</sup> Cd
<sup>88</sup> Sr	<sup>86</sup> Sr

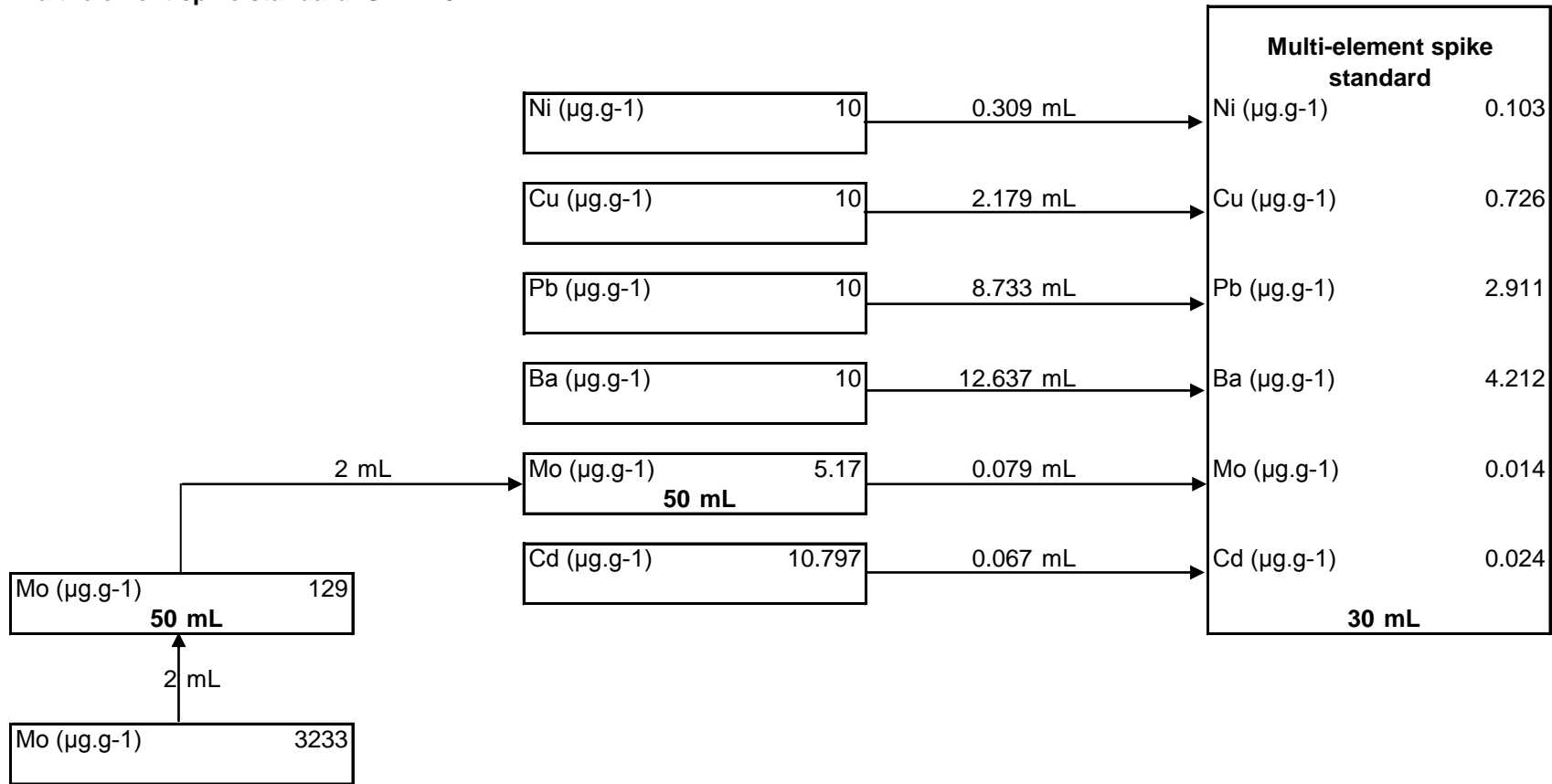


## SARM 3

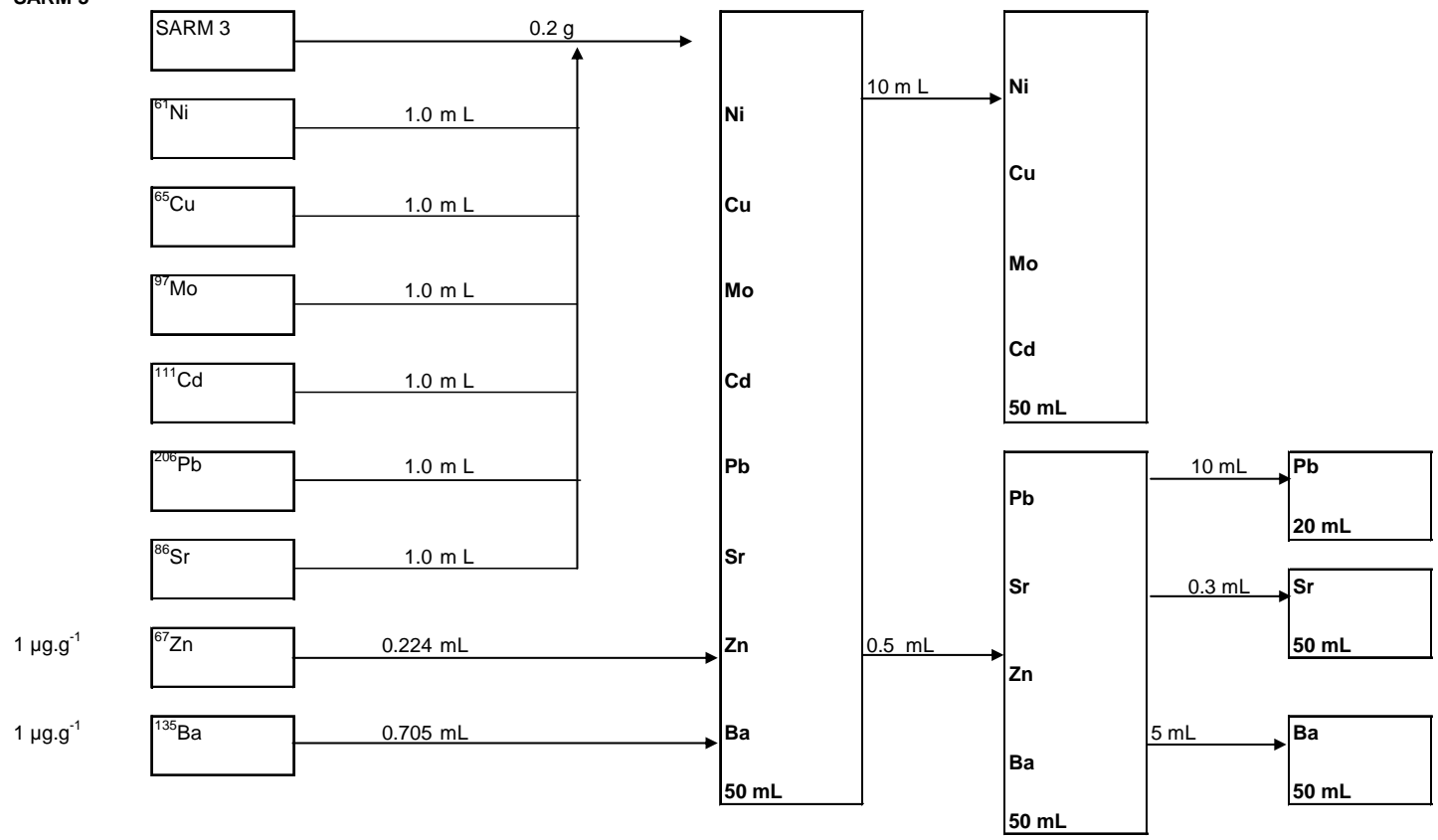
Elements	Expected concentration in SARM 3 $\mu\text{g.g}^{-1}$	Solid sample aliquot g	Amount of analyte in solid sample $\mu\text{g}$	Ratio	Required spike isotope addition for optimum ratio prior to digestion		Aliquot $\mu\text{L}$	Required multielement spike standard concentration, $\mu\text{g.g}^{-1}$	(Required) Spike stock standard concentration $\mu\text{g.g}^{-1}$	Source spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Intermediate spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Amount of spike standard addition mL	Volume of spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$	
					$\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Required spike addition for optimum ratio prior to digestion $\mu\text{g}$																		
Ni	1.7	0.2	0.34	60Ni/61Ni	3.298245614	0.103	1.0	0.103	10			20					0.309	30	50	10	50			1.8
Cu	9.4	0.2	1.88	63Cu/65Cu	2.587897757	0.726	1.0	0.726	10			20					2.179	30	50	10	50			10.4
Pb	50.1	0.2	10.02	208Pb/206Pb	3.44204947	2.911	1.0	2.911	10			20					8.733	30	50	0.5	50	10	20	1.3
Zn	435.5	0.2	87.1	66Zn/67Zn	3.892857143	22.374			1.0								0.224	30	50	0.5	50			21.9
137Ba	420	0.2	84	137Ba/135Ba	19.94178525	4.212	1.0	4.212	10			20					12.637	30	50	0.5	50	5	50	1.8
Mo	1	0.2	0.2	95Mo/97Mo	14.7032967	0.014	1.0	0.014	5.173333333	3233.333333	2	50	129.3333333	2	50		0.079	30	50	10	50			0.9
Cd	1	0.2	0.2	112Cd/111Cd	8.26646955	0.024	1.0	0.024	10.797			20					0.067	30	50	10	50			0.9
88Sr	4600	0.2	920	88Sr/86Sr	1.305005501	704.978			10								0.705	30	50	0.5	50	0.3	50	1.9



Multi-element spike standard: SARM 3



SARM 3



Reference isotope	Spike isotope
$^{60}\text{Ni}$	$^{61}\text{Ni}$
$^{63}\text{Cu}$	$^{65}\text{Cu}$
$^{208}\text{Pb}$	$^{206}\text{Pb}$
$^{66}\text{Zn}$	$^{67}\text{Zn}$
$^{137}\text{Ba}$	$^{135}\text{Ba}$
$^{95}\text{Mo}$	$^{97}\text{Mo}$
$^{112}\text{Cd}$	$^{111}\text{Cd}$
$^{88}\text{Sr}$	$^{86}\text{Sr}$

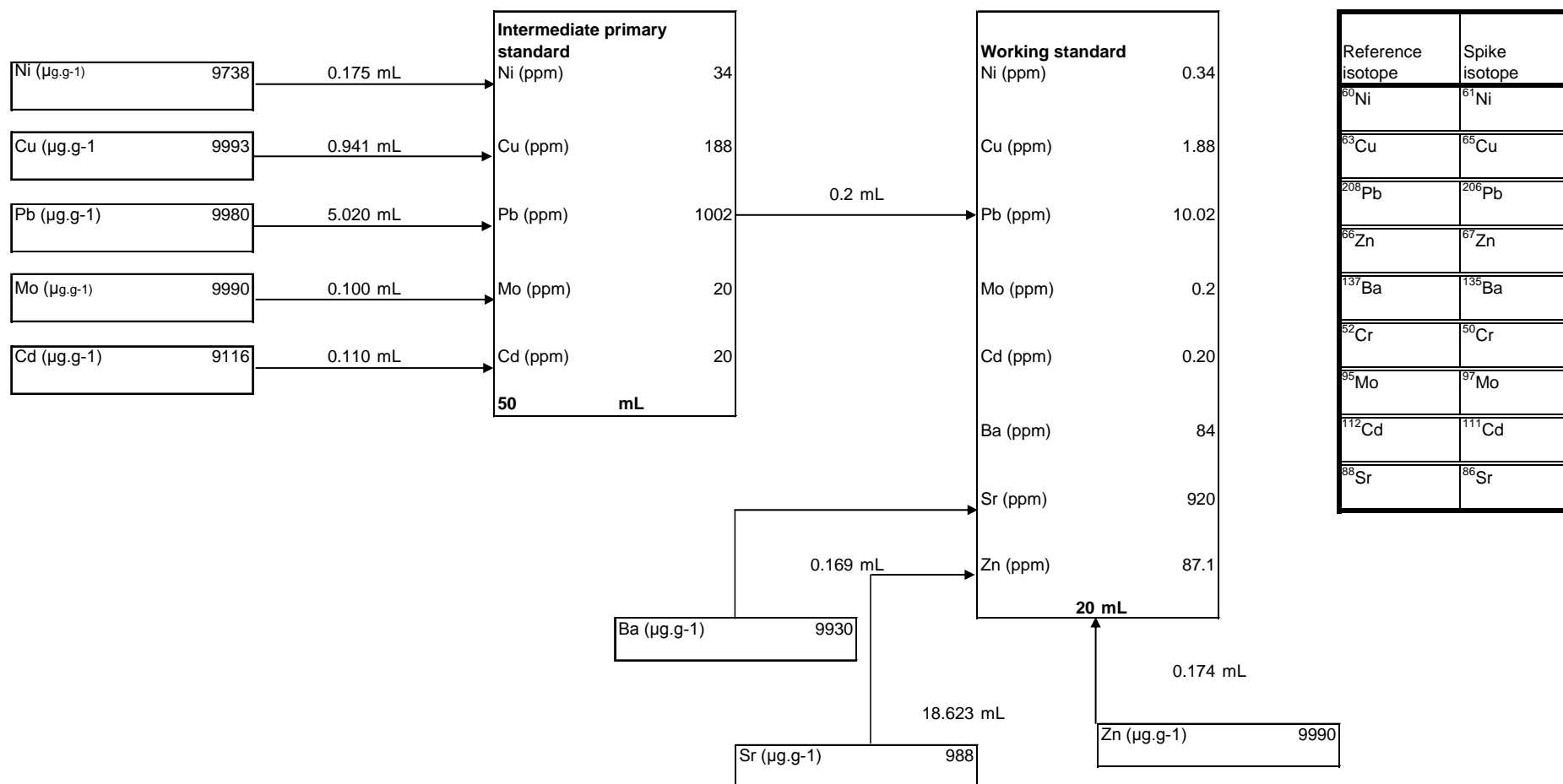


Single element standard: SARM 3

Elements	Amount of element required to match sample		Required concentration of each analyte in the final primary standard (working standard) $\mu\text{g.g}^{-1}$	Source primary standard concentration $\mu\text{g.g}^{-1}$	Uncertainty of source primary standard concentration (k=2) $\mu\text{g.g}^{-1}$		Amount of source primary standard added to IMPPS standard		Volume of primary intermediate standard	Required concentration of primary standard $\mu\text{g.g}^{-1}$	Amount of IMPPS to be added to working standard	Volume of working standard mL	Ratio $\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Required spike isotope addition for optimum ratio prior to digestion $\mu\text{g}$	Required multielement spike standard concentration, for 0.5 ml $\mu\text{g.g}^{-1}$	Spike stock standard concentration $\mu\text{g.g}^{-1}$	Amount of spike standard addition to 10 multielement spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$
	$\mu\text{g}$	mL			$\mu\text{g.g}^{-1}$	$\mu\text{g.g}^{-1}$	mL	mL															
Ni	0.34	1.0	0.34	9738	22	0.175	50	34	0.2	20	$^{60}\text{Ni}/^{61}\text{Ni}$	3.298245614	0.103	0.206	10	0.206	50						6.8
Cu	1.88	1.0	1.88	9993	16	0.941	50	188	0.2	20	$^{63}\text{Cu}/^{65}\text{Cu}$	2.587897757	0.726	1.453	10	1.453	50	10	50				7.52
Pb	10.02	1.0	10.02	9980	30	5.020	50	1002	0.2	20	$^{208}\text{Pb}/^{206}\text{Pb}$	3.44204947	2.911	5.822	10	5.822	50	3	50				12.024
Zn	87.1	1.0	87.1	9990	20	43.594	50	8710	0.2	20	$^{66}\text{Zn}/^{67}\text{Zn}$	3.892857143	22.374	44.749	10	44.749	50						1742
Ba	84	1.0	84	9930	30				0.169	20	$^{137}\text{Ba}/^{135}\text{Ba}$	19.94178525	4.212	8.425	10	8.425	50	1	50	1	50		0.672
Mo	0.2	1.0	0.2	9990	30	0.100	50	20	0.2	20	$^{95}\text{Mo}/^{97}\text{Mo}$	14.7032967	0.014	0.027	10	0.027	50	5	50				0.4
Cd	0.2	1.0	0.20	9116	25	0.110	50	20	0.2	20	$^{112}\text{Cd}/^{111}\text{Cd}$	8.26646955	0.024	0.048	10	0.048	50	5	50				0.4
Sr	920	1.0	920	988	3				18.623	20	$^{88}\text{Sr}/^{86}\text{Sr}$	1.305005501	704.978	1409.956	10	1409.956	50	5	50	5	50		184



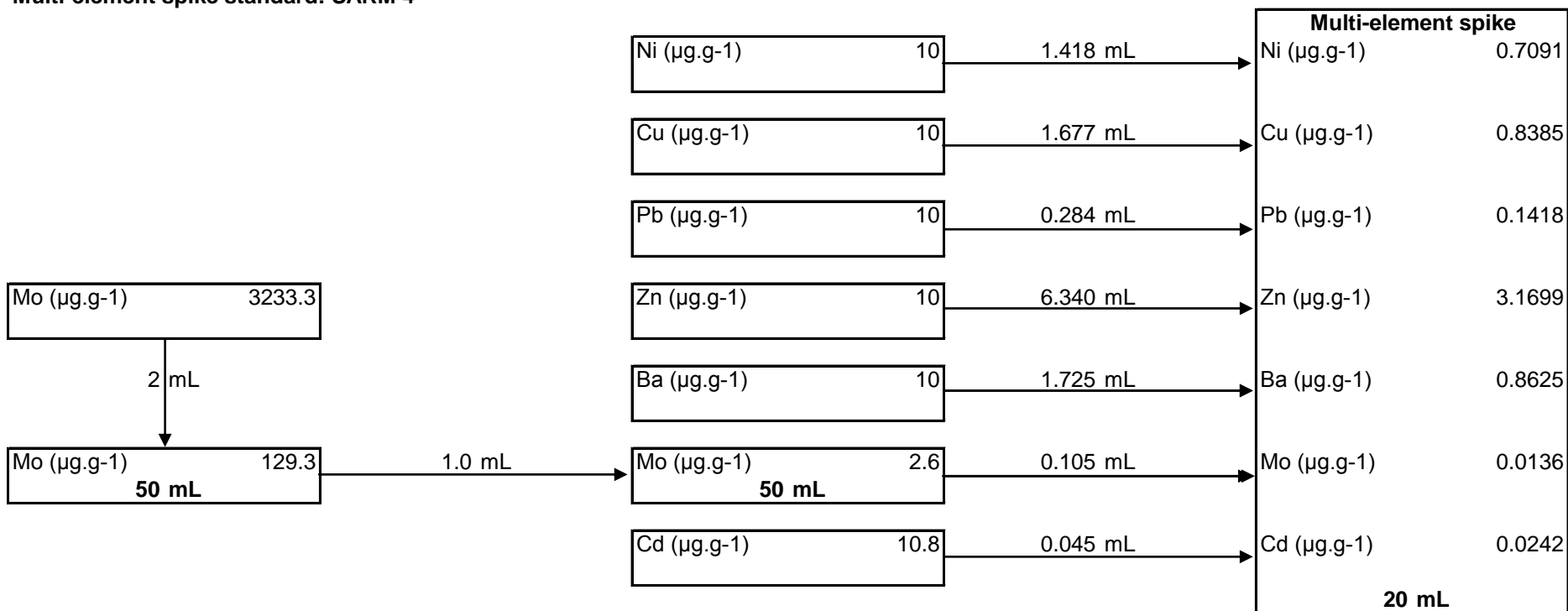
Single element primary standard: SARM 3



SARM 4

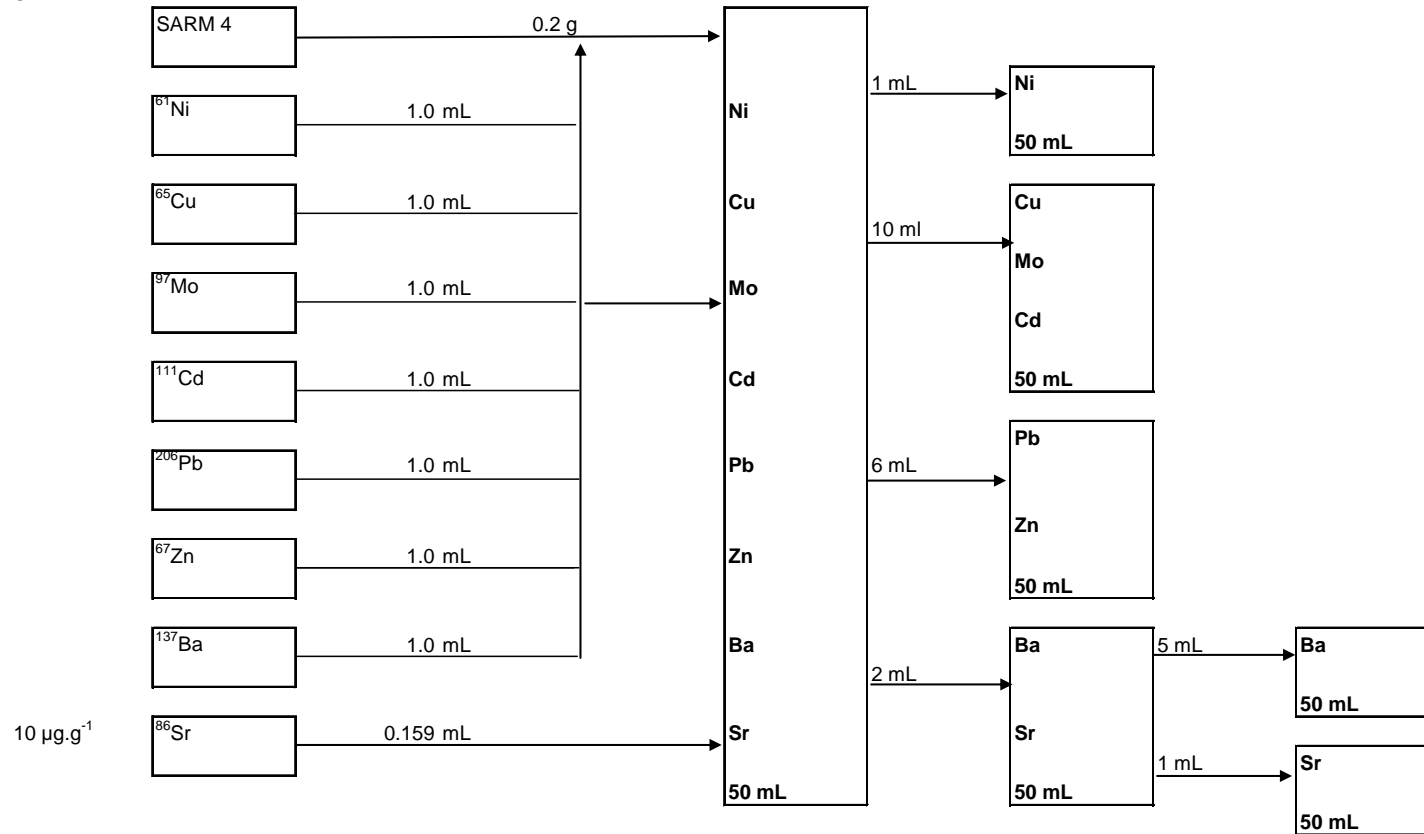
Elements	Expected concentration in SARM 4 $\mu\text{g.g}^{-1}$	Solid sample aliquot g	Amount of analyte in solid sample $\mu\text{g}$	Ratio	Required spike isotope addition for optimum ratio prior to digestion		Aliquot mL	Required multielement spike standard concentration, $\mu\text{g.g}^{-1}$	Spike stock standard concentration $\mu\text{g.g}^{-1}$	Source spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Intermediate spike stock standard concentration	Amount of spike standard addition mL	Volume of intermediate spike standard mL	Amount of spike standard addition mL	Volume of spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$
					$\frac{C_{\text{sample}}}{C_{\text{spike}}}$	$\mu\text{g}$																	
<sup>62</sup> Ni/ <sup>61</sup> Ni	124.3	0.2	24.86	<sup>62</sup> Ni/ <sup>61</sup> Ni	35.06014435	0.7091	1.0	0.7091	10							1.418	20	50	1	50			10.2
Cu	10.85	0.2	2.17	<sup>63</sup> Cu/ <sup>65</sup> Cu	2.587897757	0.8385	1.0	0.8385	10							1.677	20	50	10	50			12.0
Pb	2.44	0.2	0.488	<sup>208</sup> Pb/ <sup>206</sup> Pb	3.44204947	0.1418	1.0	0.1418	10							0.284	20	50	6	50			1.5
Zn	61.7	0.2	12.34	<sup>66</sup> Zn/ <sup>67</sup> Zn	3.892857143	3.1699	1.0	3.1699	10							6.340	20	50	6	50			37.2
<sup>137</sup> Ba	86	0.2	17.2	<sup>137</sup> Ba/ <sup>135</sup> Ba	19.94178525	0.8625	1.0	0.8625	10							1.725	20	50	2	50	5	50	1.4
Mo	1	0.2	0.2	<sup>95</sup> Mo/ <sup>97</sup> Mo	14.7032967	0.0136	1.0	0.0136	2.586666667	3233.333333	2	50	129.3333333	1	50	0.105	20	50	10	50			0.9
Cd	1	0.2	0.2	<sup>112</sup> Cd/ <sup>111</sup> Cd	8.26646955	0.0242	1.0	0.0242	10.797							0.045	20	50	10	50			0.9
<sup>88</sup> Sr	260	0.2	52	<sup>88</sup> Sr/ <sup>86</sup> Sr	1.305005501	39.8466			10							0.159		50	2	50	1	50	1.5

Multi-element spike standard: SARM 4





SARM 4



Reference isotope	Spike isotope
<sup>60</sup> Ni	<sup>61</sup> Ni
<sup>63</sup> Cu	<sup>65</sup> Cu
<sup>208</sup> Pb	<sup>206</sup> Pb
<sup>66</sup> Zn	<sup>65</sup> Zn
<sup>135</sup> Ba	<sup>137</sup> Ba
<sup>95</sup> Mo	<sup>97</sup> Mo
<sup>112</sup> Cd	<sup>111</sup> Cd
<sup>88</sup> Sr	<sup>86</sup> Sr

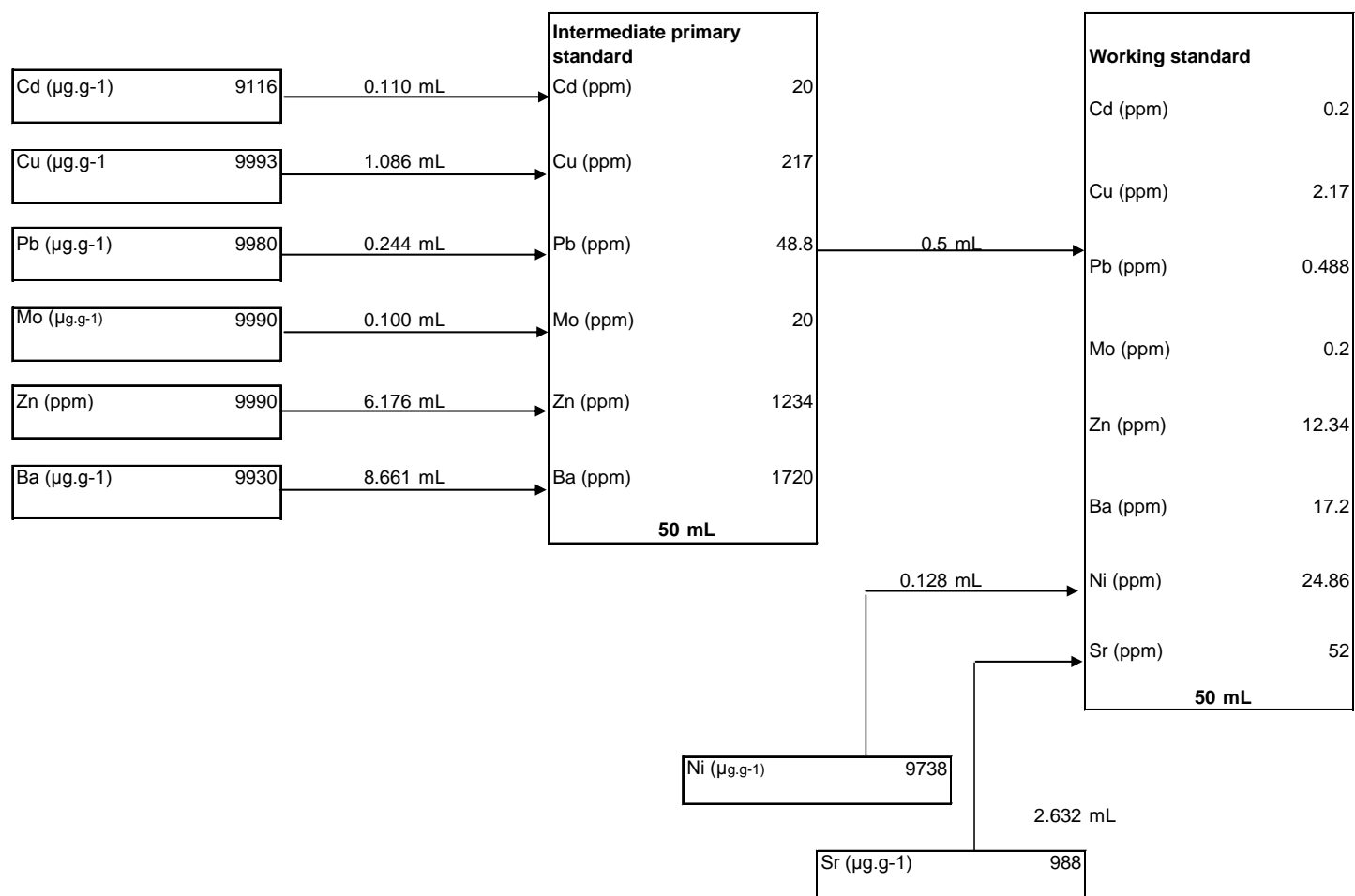


Single element standard: SARM 4

Elements	Amount of element required to match sample		Required concentration of each analyte in the final primary standard (working standard) $\mu\text{g.g}^{-1}$	Source primary standard concentration $\mu\text{g.g}^{-1}$	Uncertainty of source primary standard concentration (k=2) $\mu\text{g.g}^{-1}$		Amount of source primary standard added to IMPPS standard mL	Volume of primary intermediate standard mL	Required concentration of intermediate primary standard $\mu\text{g.g}^{-1}$	Amount of IMPPS to be added to working standard mL	Volume of working standard mL	Ratio	$\frac{C_{\text{sample}}}{C_{\text{spike}}}$	Required spike isotope addition for optimum ratio prior to digestion $\mu\text{g}$	Required multielement spike standard concentration, for 0.5 ml $\mu\text{g.g}^{-1}$	Spike stock standard concentration $\mu\text{g.g}^{-1}$	Amount of spike standard addition to 10 multielement spike standard mL	Volume-1 volume after digestion	Aliquot-1 ml	Volume-2 ml	Aliquot-2 ml	Volume-3	Expected working sample concentration $\text{ng.ml}^{-1}$	
	$\mu\text{g}$	Aliquot mL																						
Ni	24.86	1.0	24.86	9738	22					0.128	50	$^{60}\text{Ni}/^{61}\text{Ni}$	3.298245614	7.537	15.075	10	15.075	50						497.2
Cu	2.17	1.0	2.17	9993	16	1.086	50	217	0.5	50	$^{63}\text{Cu}/^{65}\text{Cu}$	2.587897757	0.839	1.677	10	1.677	50							43.4
Pb	0.488	1.0	0.488	9980	30	0.244	50	48.8	0.5	50	$^{208}\text{Pb}/^{206}\text{Pb}$	3.44204947	0.142	0.284	10	0.284	50							0.3904
Zn	12.34	1.0	12.34	9990	20	6.176	50	1234	0.5	50	$^{66}\text{Zn}/^{67}\text{Zn}$	3.892857143	3.170	6.340	10	6.340	50	10	50					49.36
Ba	17.2	1.0	17.2	9930	30	8.661	50	1720	0.5	50	$^{137}\text{Ba}/^{135}\text{Ba}$	19.94178525	0.863	1.725	10	1.725	50	2	50		2	50		0.5504
Mo	0.2	1.0	0.2	9990	30	0.100	50	20	0.5	50	$^{95}\text{Mo}/^{97}\text{Mo}$	14.7032967	0.014	0.027	10	0.027	50	10	50					0.8
Cd	0.2	1.0	0.2	9116	25	0.110	50	20	0.5	50	$^{112}\text{Cd}/^{111}\text{Cd}$	8.26646955	0.024	0.048	10	0.048	50	20	50					1.6
Sr	52	1.0	52	988	3					2.632	50	$^{88}\text{Sr}/^{86}\text{Sr}$	1.305005501	39.847	79.693	10	79.693	50	0.2	50	5	50		0.416



Single element primary standard: SARM 4



Reference isotope	Spike isotope
$^{60}\text{Ni}$	$^{61}\text{Ni}$
$^{63}\text{Cu}$	$^{65}\text{Cu}$
$^{208}\text{Pb}$	$^{206}\text{Pb}$
$^{66}\text{Zn}$	$^{67}\text{Zn}$
$^{137}\text{Ba}$	$^{135}\text{Ba}$
$^{95}\text{Mo}$	$^{97}\text{Mo}$
$^{112}\text{Cd}$	$^{111}\text{Cd}$
$^{88}\text{Sr}$	$^{86}\text{Sr}$

## Appendix H

### Example of the use of partial derivatives as the sensitivity coefficients for the calculation of the combined standard uncertainty

Table 1: Calculation of the combined standard uncertainty of sample blend A for SARM 2 spiked after digestion

Model: 
$$m_x = \frac{Aliquot-1}{Volume-1} \times Aliquot-2$$

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty $u_i$	Sensitivity coefficient $c_i$	Sensitivity coefficient $c_i$	Uncertainty contribution $c_i \times u_i$	Type A/B	Degrees of freedom
Aliquot-1 (g)	0.20088				0.00002	$\frac{\partial m_x}{\partial Aliquot-1} = \frac{1}{Volume-1} \times Aliquot-2$	0.020147306	4.02946E-07	B	$\infty$
Volume-1 (g)	52.72417				0.00019	$\frac{\partial m_x}{\partial Volume1} = \frac{-Aliquot1}{Volume1^2} \times Aliquot2$	-7.67616E-05	-1.45847E-08	B	$\infty$
Aliquot-2 (g)	1.06225				0.00002	$\frac{\partial m_x}{\partial Aliquot-2} = \frac{Aliquot-1}{Volume-1}$	0.003810017	7.62003E-08	B	$\infty$
								4.10347E-07		

$m_x$	0.004047191
$u_c$	4.10347E-07
$v_{eff}$	$\infty$
k	2
U	8.20694E-07

Table 2: Combined standard uncertainty calculated with partial derivatives for the measured ratio of the <sup>135</sup>Ba spike

$$Ratio = \frac{A(^{137}Ba)}{A(^{135}Ba)}$$

Model:

Parameter	Estimate	Specification	Probability distribution	Divisor	Std uncertainty	Sensitivity coefficient	Uncertainty contribution	Type A/B	Degrees of freedom
A( <sup>135</sup> Ba)	93.39	0.02	Rectangular	$\sqrt{3}$	0.011547005	-0.000102044	-1.17831E-06	B	infinity
A( <sup>137</sup> Ba)	0.89	0.01	Rectangular	$\sqrt{3}$	0.005773503	0.010707785	6.18214E-05	B	infinity
							6.18327E-05		

$Ratio$	0.009529928
$u_c$	6.18327E-05
$v_{eff}$	infinity
<b>k</b>	2
<b>U</b>	0.000123665

Table 3: Calculation of the combined standard uncertainty of the moisture determination of SARM 2 with partial derivatives

$$\text{Moisture} = \frac{\text{Dry}_{\text{sample}}}{\text{Wet}_{\text{sample}}}$$

Model:

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty $u_i$	Sensitivity coefficient $c_i$	Sensitivity coefficient $c_i$	Uncertainty contribution $c_i \times u_i$	Type A/B	Degrees of freedom
$\text{Wet}_{\text{sample}}$	2.65319				0.00002	$\frac{\partial \text{Moisture}}{\partial \text{Wet}_{\text{sample}}} = \frac{-\text{Dry}_{\text{sample}}}{\text{Wet}_{\text{sample}}^2}$	-0.376433153	-7.52866E-06	B	$\infty$
$\text{Dry}_{\text{sample}}$	2.64987				0.00002	$\frac{\partial \text{Moisture}}{\partial \text{Dry}_{\text{sample}}} = \frac{1}{\text{Wet}_{\text{sample}}}$	0.376904783	7.5381E-06	B	$\infty$
								1.06538E-05		

Moisture 0.998748676  
 $u_c$  1.06538E-05  
 $v_{\text{eff}}$   $\infty$   
**k** 2  
**U** 2.13076E-05  
**RSU** 0.002133431



Table 4: Calculation of the combined standard uncertainty of the amount content, Cz, of the primary assay standard with partial derivatives as the sensitivity coefficients.

$$C_{PS} = C_{source} \times \frac{Aliquot - 1}{Volume - 1}$$

Model:

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty ui	Sensitivity coefficient ci	Sensitivity coefficient ci	Uncertainty contribution ci x ui	Type A/B	Degrees of freedom
$C_{source}$	9930	30	Normal	2	15	$\frac{\partial C_{PS}}{\partial C_{source}} = \frac{Aliquot - 1}{Volume - 1}$	0.097909698	1.468645472	B	$\infty$
Aliquot-1 (g)	4.93136				0.00006	$\frac{\partial C_{PS}}{\partial Aliquot - 1} = \frac{C_{source}}{Volume - 1}$	197.1552072	0.011829312	A	$\infty$
Volume-1 (g)	50.36641				0.00019	$\frac{\partial C_{PS}}{\partial Volume - 1} = \frac{-C_{source} \times Aliquot - 1}{Volume - 1^2}$	-19.30340683	-0.003667647	A	$\infty$
								1.468697691		

$$C_{PS} = 972.2433026 \mu\text{g.g}^{-1}$$

$$u_c = 1.468697691$$

$$v_{eff} = \infty$$

$$k = 2$$

$$U = 2.937395382$$

Cz, Amount content of Ba in the primary assay standard blend

$$C_z = C_{PS} \times \frac{Aliquot - 1}{Volume - 1}$$

Model:

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty ui	Sensitivity coefficient ci	Sensitivity coefficient ci	Uncertainty contribution ci x ui	Type A/B	Degrees of freedom
$C_{PS}$	972.2433026	2.937395382	Normal	k=2	1.468697691	$\frac{\partial C_z}{\partial C_{PS}} = \frac{Aliquot - 1}{Volume - 1}$	0.009604921	0.014106726	A/B	$\infty$
Aliquot-1(g)	0.49843				0.00002	$\frac{\partial C_z}{\partial Aliquot - 1} = \frac{C_{PS}}{Volume - 1}$	18.73546996	0.000374709	A	$\infty$
Volume-1(g)	51.89319				0.00019	$\frac{\partial C_z}{\partial Volume - 1} = \frac{-C_{PS} \times Aliquot - 1}{Volume - 1^2}$	-0.179952712	-3.4191E-05	A	$\infty$
								0.014111743		

$$C_z = 9.338320295$$

$$u_c = 0.014111743$$

$$v_{eff} = \infty$$

$$k = 2$$

$$U = 0.028223485$$

$$RSU = 0.302232998$$



Table 5: Calculation of the combined standard uncertainty of the isotope dilution experiment for Ba in SARM 2 with partial derivatives

$$C_x = C_z \times \frac{M_y \cdot M_z (K_y \cdot R_y - K_b \cdot R_b) \cdot (K_b \cdot R_b' - K_z \cdot R_z)}{w \cdot M_x \cdot M_y \cdot (K_b \cdot R_b - K_x \cdot R_x) \cdot (K_y \cdot R_y - K_b \cdot R_b')}$$

Model:	Parameter	Estimate	Specification	Probability distribution	Divisor	Std uncertainty	Sensitivity coefficient	Uncertainty contribution	Type A/B	Degrees of freedom
	Rb	6.453850				0.04405	1021.88309	45.01676 A		398
	Rb'	6.450050				0.023688	-1023.30283	-24.24008 A		398
	Rx	11.161800				0.05141	-589.38448	-30.30220 A		796
	Rz	11.148725				0.03486	590.54790	20.58517 A		796
	Kb	1.019742				0.00066	6467.39807	4.24753 A		23
	Kb'	1.019742				0.00066	-6472.57020	-4.25093 A		23
	Kx	1.019742				0.00066	-6451.22880	-4.23691 A		23
	Kz	1.019742				0.00066	6456.39135	4.24030 A		23
	Cz	9.338320				0.01411	297.14045	4.19317		infinity
	Ry	0.038124				0.00012	0.25632	0.00003 B		infinity
	Ky	1.019742				0.00066	0.00958	0.00001 A		23
	mx	0.004047191				4.10347E-07	-685609.53884	-0.28134		infinity
	my	0.55215				0.00002	5025.43271	0.10051 B		infinity
	m'y	0.48306				0.00002	-5744.19880	-0.11488 B		infinity
	mz	1.05224				0.00002	2637.03402	0.05274 B		infinity
	w	0.998749				0.00001	-2778.26919	-0.02960		infinity
	G	1.000000				0.002000	2774.79267	5.54959 B		infinity
	B	1.000000				0.002000	2774.79267	5.54959 B		infinity
								64.08893		

Cx	Cx	2774.792673
uc	uc	64.088931
veff	veff	1346.731296
k	k	2
U	U	128.177862
REU	REU(%)	4.61937



## Appendix I

### Example of the use of numerical approximation for the calculation of the sensitivity coefficients to be used for the calculation of the combined standard uncertainty

**Table 1: Calculation combined standard uncertainty of the aliquot of a SARM 2 sample blend with the numerical approximation method**

	Parameter	Value	SU	$Y_{pi(n)}$	$V-V*0.99$	Aliquot-1 (g)	Volume-1 (g)	Aliquot-2 (g)
Aliquot-1 (g)	Aliquot-1 (g)	0.200620	0.000020	249	0.00201	0.20263	0.20062	0.20062
Volume-1 (g)	Volume-1 (g)	52.474600	0.000190	249	0.52475	52.47460	52.99935	52.47460
Aliquot-2 (g)	Aliquot-2 (g)	1.053230	0.000020	249	0.01053	1.05323	1.05323	1.06376
<b>Concentration (ug/g)</b>		<b>0.004026691</b>				<b>0.004067</b>	<b>0.003987</b>	<b>0.004067</b>
<b>Combined uncertainty</b>		<b>0.000000409</b>			#	<b>0.000004</b>	<b>-0.000004</b>	<b>0.000004</b>
<b>Exp. Unc</b>		<b>0.000000818</b>			$C_{pi}=\#/(V-V*0.99)$	<b>0.020007</b>	<b>-0.000008</b>	<b>0.00382</b>
					$C_{pi} * u_{pi}$	<b>0.000000</b>	<b>0.000000</b>	<b>0.000000</b>
	SUM of $(C_{pi} * u_{pi})^2$	0.000000			$(C_{pi} * u_{pi})^2$	0.000000	0.000000	0.000000
	SQRT (SUM $(C_{pi} * u_{pi})^2$ )	0.000000						
					$(C_{pi} * u_{pi})^4$	0.000000	0.000000	0.000000
	SUM of $(C_{pi} * u_{pi})^4 / Y_{pi}$	0.000000			$(C_{pi} * u_{pi})^4 / Y_{pi}$	0.000000	0.000000	0.000000
	<b><math>Y_{eff(n)}</math>, total degree of freedom</b>	<b>267.71158</b>	<b>k=1.984, 95%</b>					



Table 2: Calculation of the measured ratio of the <sup>135</sup>Ba spike with the numerical approximation method

	Parameter	Value	SU	Y <sub>pi(n)</sub>	V-V*0.99	A(137Ba)	A(135Ba)
A( <sup>137</sup> Ba)	A( <sup>137</sup> Ba)	0.89	0.02	249	0.00890	0.89890	0.89000
A( <sup>135</sup> Ba)	A( <sup>135</sup> Ba)	93.39	0.010000	249	0.93390	93.39000	94.32390
<b>Ratio</b>		<b>0.009529928</b>				<b>0.009625228</b>	<b>0.009435573</b>
<b>Combined uncertainty</b>		<b>0.000214158</b>			#	<b>0.00010</b>	<b>-0.00009</b>
<b>Exp. Unc</b>		<b>0.000428316</b>			C <sub>pi</sub> =#/(V-V*0.99)	<b>0.01071</b>	<b>-0.00010</b>
					C <sub>pi</sub> *u <sub>pi</sub>	<b>0.00021</b>	<b>0.00000</b>
	SUM of (C <sub>pi</sub> *u <sub>pi</sub> ) <sup>2</sup>	0.00000			(C <sub>pi</sub> *u <sub>pi</sub> ) <sup>2</sup>	0.00000	0.00000
	SQRT (SUM (C <sub>pi</sub> *u <sub>pi</sub> ) <sup>2</sup> )	0.00021			(C <sub>pi</sub> *u <sub>pi</sub> ) <sup>4</sup>	0.00000	0.00000
	SUM of (C <sub>pi</sub> *u <sub>pi</sub> ) <sup>4</sup> / Y <sub>pi</sub>	0.00000			(C <sub>pi</sub> *u <sub>pi</sub> ) <sup>4</sup> / Y <sub>pi</sub>	0.00000	0.00000
	<b>Y<sub>eff (n)</sub>, total degree of freedom</b>	<b>249.01108</b>	<b>k=1.984, 95%</b>				

Table 3: Calculation of the combined standard uncertainty of the moisture determination of SARM 2 with the numerical approximation method

	Parameter	Value	SU	Y <sub>pi(n)</sub>	V-V*0.99	Dry sample (g)	Wet sample (g)
Dry sample (g)	Dry sample (g)	2.649870	0.000020	249	0.02650	2.67637	2.64987
Wet sample (g)	Wet sample (g)	2.653190	0.000190	249	0.02653	2.65319	2.67972
<b>Concentration (ug/g)</b>		<b>0.998748676</b>				<b>1.008736163</b>	<b>0.988860075</b>
<b>Combined uncertainty</b>		<b>0.000071214</b>			#	<b>0.00999</b>	<b>-0.00989</b>
<b>Exp. Unc</b>		<b>0.000142428</b>			C <sub>pi</sub> =#/(V-V*0.99)	<b>0.37690</b>	<b>-0.37271</b>
					C <sub>pi</sub> *u <sub>pi</sub>	<b>0.00001</b>	<b>-0.00007</b>
	SUM of (C <sub>pi</sub> *u <sub>pi</sub> ) <sup>2</sup>	0.00000			(C <sub>pi</sub> *u <sub>pi</sub> ) <sup>2</sup>	0.00000	0.00000
	SQRT (SUM (C <sub>pi</sub> *u <sub>pi</sub> ) <sup>2</sup> )	0.00007			(C <sub>pi</sub> *u <sub>pi</sub> ) <sup>4</sup>	0.00000	0.00000
	SUM of (C <sub>pi</sub> *u <sub>pi</sub> ) <sup>4</sup> / Y <sub>pi</sub>	0.00000			(C <sub>pi</sub> *u <sub>pi</sub> ) <sup>4</sup> / Y <sub>pi</sub>	0.00000	0.00000
	<b>Y<sub>eff (n)</sub>, total degree of freedom</b>	<b>254.64231</b>	<b>k=1.984, 95%</b>				



**Table 4: Calculation of the combined standard uncertainty for the amount content, Cz, of Ba in SARM 2 with the numerical approximation method**

	Parameter	Value	SU	$Y_{pi(n)}$	V-V*0.99	Csource	Aliquot-1 (g)	Volume-1 (g)
Csource	Csource	9930.000000	15.000000	249	99.30000	10029.30000	9930.00000	9930.00000
Aliquot-1 (g)	Aliquot-1 (g)	4.931360	0.000060	249	0.04931	4.93136	4.98067	4.93136
Volume-1 (g)	Volume-1 (g)	50.366410	0.000190	249	0.50366	50.36641	50.36641	50.87007
<b>Concentration (ug/g)</b>		<b>972.243303</b>				<b>981.965736</b>	<b>981.965736</b>	<b>962.617131</b>
<b>Combined uncertainty</b>		<b>1.468698</b>		#		<b>9.72243</b>	<b>9.72243</b>	<b>-9.62617</b>
<b>Exp. Unc</b>		<b>2.937395</b>		$C_{pi}=\#/(V-V*0.99)$		<b>0.09791</b>	<b>197.15521</b>	<b>-19.11228</b>
				$C_{pi}*u_{pi}$		<b>1.46865</b>	<b>0.01183</b>	<b>-0.00363</b>
	SUM of $(C_{pi}*u_{pi})^2$	2.15707		$(C_{pi}*u_{pi})^2$		2.15692	0.00014	0.00001
	SQRT (SUM $(C_{pi}*u_{pi})^2$ )	1.46870		$(C_{pi}*u_{pi})^4$		4.65230	0.00000	0.00000
	SUM of $(C_{pi}*u_{pi})^4 / Y_{pi}$	0.01868		$(C_{pi}*u_{pi})^4 / Y_{pi}$		0.01868	0.00000	0.00000
	<b><math>Y_{eff(n)}</math>, total degree of freedom</b>	<b>249.03535</b>	k=1.984, 95%					

**Cz, Amount content of Ba in the spiked aliquot of primary standard**

	Parameter	Value	SU	$Y_{pi(n)}$	V-V*0.99	Cps	Aliquot-1 (g)	Volume-1 (g)
Cps	Cps	972.243303	1.468698	249	9.72243	981.96574	972.24330	972.24330
Aliquot-1(g)	Aliquot-1 (g)	0.498430	0.000020	249	0.00498	0.49843	0.50341	0.49843
Volume-1(g)	Volume-1 (g)	51.893190	0.000190	249	0.51893	51.89319	51.89319	52.41212
<b>Concentration (ug/g)</b>		<b>9.338320</b>				<b>9.431703</b>	<b>9.431703</b>	<b>9.245862</b>
<b>Combined uncertainty</b>		<b>0.014112</b>		#		<b>0.09338</b>	<b>0.09338</b>	<b>-0.09246</b>
<b>Exp. Unc</b>				$C_{pi}=\#/(V-V*0.99)$		<b>0.00960</b>	<b>18.73547</b>	<b>-0.17817</b>
				$C_{pi}*u_{pi}$		<b>0.01411</b>	<b>0.00037</b>	<b>-0.00003</b>
	SUM of $(C_{pi}*u_{pi})^2$	0.00020		$(C_{pi}*u_{pi})^2$		0.00020	0.00000	0.00000
	SQRT (SUM $(C_{pi}*u_{pi})^2$ )	0.01411		$(C_{pi}*u_{pi})^4$		0.00000	0.00000	0.00000
	SUM of $(C_{pi}*u_{pi})^4 / Y_{pi}$	0.00000		$(C_{pi}*u_{pi})^4 / Y_{pi}$		0.00000	0.00000	0.00000
	<b><math>Y_{eff(n)}</math>, total degree of freedom</b>	<b>249.35424</b>	k=1.984, 95%					

Table 5: Calculation of the combined standard uncertainty of the double isotope dilution experiment for Ba in SARM 2 with the numerical approximation method

Parameter	Value	SU	Y <sub>rel</sub>	V-V*0.99	Rb	Rb'	Rx	Rz	Kb	Kb'	Kx	Kz	Cz	Ry	Ky	mx	my	m'y	mz	w	G	B	
Rb	Measured ratio in the blend b	6.453850	0.044053	249	0.06454	6.51899	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	6.45385	
Rb'	Measured ratio in the blend b'	6.450050	0.023689	249	0.06450	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	6.45005	
Rx	Measured ratio in the sample	11.161800	0.051413	249	0.11162	11.16180	11.16180	11.27342	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	11.16180	
Rz	Measured ratio in the primary standard	11.148725	0.034858	249	0.11149	11.14873	11.14873	11.14873	11.26021	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	11.14873	
Kb	Mass bias correction factor for Rb	1.019742	0.000657	20	0.01020	1.01974	1.01974	1.01974	1.01974	1.02294	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	
Kb'	Mass bias correction factor for Rb'	1.019742	0.000657	20	0.01020	1.01974	1.01974	1.01974	1.01974	1.02294	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	
Kx	Mass bias correction factor for Rx	1.019742	0.000657	20	0.01020	1.01974	1.01974	1.01974	1.01974	1.01974	1.02294	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	
Kz	Mass bias correction factor for Rz	1.019742	0.000657	20	0.01020	1.01974	1.01974	1.01974	1.01974	1.01974	1.02294	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	
Cz	Amount content of element in the sample, ug/g	9.518368	0.000396	100	0.09518	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	9.51837	
Ry	Measured ratio in the spike	0.038124	0.000214	249	0.00388	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	0.03812	
Ky	Mass bias correction factor for Ry	1.019742	0.000657	18	0.01020	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	1.01974	
mx	Mass of sample in blend b, g	0.004047191	4.10347E-07	100	0.00004	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	0.00405	
my	Mass of spike in blend b, g	0.55215	0.00002	100	0.00552	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	0.55215	
m'y	Mass of spike in blend b', g	0.48306	0.00002	100	0.00483	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	0.48306	
mz	Mass of primary standard in blend b', g	1.05224	0.00002	100	0.01052	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	1.05224	
w	Dry mass correction	0.998749	0.000102	1	0.00989	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	0.99875	
G	Digestion correction factor	1.000000	0.002000	100	0.01000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	
B	Blank correction factor	1.00000	0.002000	1	0.01000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	
Concentration (ug/g)		2828.292177				2896.448866	2761.686070	2762.790805	2895.400142	2896.448866	2761.686070	2762.790805	2895.400142	2896.448866	2761.686070	2762.790805	2895.400142	2896.448866	2761.686070	2762.790805	2895.400142	2896.448866	
Combined uncertainty		65.199349				68.15669	-66.60611	-65.50137	67.10796	68.15669	-66.60611	-65.50137	67.10796	68.15669	28.28292	0.00010	-28.00289	28.28292	-28.00289	28.28292	-28.00289	-28.00289	28.28292
Exp. Unc						1056.06249	-1032.64482	-586.83521	601.93399	6683.71611	-6531.65990	-6423.32517	6580.87406	297.14045	0.26128	0.00977	#####	5122.32578	-5796.98026	2687.87746	-2803.79774	-2800.28928	2828.29218
	SUM of (Cp1*upi)^2	4250.95516				(C <sub>p1</sub> *u <sub>p1</sub> )^2	2164.33923	598.35863	910.29738	440.24717	19.26857	18.40181	17.79645	18.68016	0.01382	0.00000	0.00000	0.08061	0.01050	0.01344	0.00289	0.08108	31.36648
	SQRT (SUM (Cp1*upi)^2)	65.19935				(C <sub>p1</sub> *u <sub>p1</sub> )^4	4684364.28395	#####	828641.32638	19381.57024	371.27780	338.62674	316.71354	348.94848	0.00019	0.00000	0.00000	0.00650	0.00011	0.00018	0.00001	0.00657	983.85609
	SUM of (Cp1*upi)^4 / Yp1	25459.28045				(C <sub>p1</sub> *u <sub>p1</sub> )^4 / Y <sub>p1</sub>	18812.70797	1437.88374	3327.87661	778.38382	18.56389	16.93134	15.83566	17.44742	0.00000	0.00000	0.00000	0.00006	0.00000	0.00000	0.00000	0.00657	983.85609
	Y <sub>rel</sub> total degree of freedom	709.78517	k=1.984, 95%																			1023.80459	



## Appendix J

### Example of the use of the power law for the calculation of the combined standard uncertainty

**Table 1: Calculation of the combined standard uncertainty of an aliquot of SARM 2 with the Power Law**

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty $u_i$	Relative uncertainty	Type A/B	Degrees of freedom
Aliquot-1 (g)	0.20088				0.00002	9.95619E-05	A	infinity
Volume-1 (g)	52.72417				0.00019	3.60366E-06	A	infinity
Aliquot-2 (g)	1.06225				0.00002	1.8828E-05	A	infinity
						0.000101391		

$m_x$	0.004047191
$u_c$	4.10347E-07
$v_{eff}$	$\infty$
<b>k</b>	2
<b>U</b>	8.20694E-07

**Table 2: Calculation of the combined standard uncertainty of the  $^{135}\text{Ba}$  spike ratio with the Power Law**

Parameter	Estimate	Specification	Probability distribution	Divisor	Std uncertainty	Relative uncertainty	Type A/B	Degrees of freedom
$A(^{135}\text{Ba})$	93.39	0.02	Rectangular	$\sqrt{3}$	0.011547005	0.000123643	B	infinity
$A(^{137}\text{Ba})$	0.89	0.01	Rectangular	$\sqrt{3}$	0.005773503	0.006487082	B	infinity
						0.00648826		

$Ratio$	0.009529928
$u_c$	6.18327E-05
$v_{eff}$	infinity
<b>k</b>	2
<b>U</b>	0.000123665

**Table 3: Calculation of the combined standard uncertainty of the moisture determination of SARM 2 with the Power Law**

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty $u_i$	Relative uncertainty	Type A/B	Degrees of freedom
<i>Wet sample</i>	2.65319				0.00002	7.5381E-06	B	$\infty$
<i>Dry sample</i>	2.64987				0.00002	7.54754E-06	B	$\infty$
						1.06672E-05		

<b>%Moisture</b>	0.998748676
$u_c$	1.06538E-05
$v_{eff}$	$\infty$
<b>k</b>	2
<b>U</b>	2.13076E-05
<b>RSU</b>	0.002133431

**Table 4: Calculation of the combined standard uncertainty of the amount content,  $C_z$ , of Ba in SARM 2 with the Power Law**

Parameter	Estimate	Specification	Probability distribution	Divisor	Standard uncertainty $u_i$	Relative uncertainty	Type A/B	Degrees of freedom
$C_{source}$	9930	30	Normal	2	15	0.001510574	B	$\infty$
Aliquot-1 (g)	4.93136				0.00006	1.2167E-05	A	$\infty$
Volume-1 (g)	50.36641				0.00019	3.77236E-06	A	$\infty$

0.001510628

$C_{PS}$  972.2433026  $\mu\text{g}\cdot\text{g}^{-1}$

$u_c$  1.468697691

$v_{eff}$   $\infty$

**k** 2

**U** 2.937395382



**Table 5: Calculation of the combined standard uncertainty of the isotope dilution experiment for Ba in SARM 2 with the Power Law**

	Parameter	Estimate	Std uncertainty	Relative uncertainty	Type A/B	Degrees of freedom
Rb	Measured ratio in the blend b	0.965550	0.00035	0.00037	A	398
Rb'	Measured ratio in the blend b'	0.998100	0.001273	0.00128	A	398
Rx	Measured ratio in the sample	1.720050	0.00170	0.00099	A	796
Rz	Measured ratio in the primary standard	1.719400	0.00278	0.00162	A	796
Kb	Mass bias correction factor for Rb	1.009371	0.00025	0.00025	A	23
Kb'	Mass bias correction factor for Rb'	1.009371	0.00025	0.00025	A	23
Kx	Mass bias correction factor for Rx	1.009371	0.00025	0.00025	A	23
Kz	Mass bias correction factor for Rz	1.009371	0.00025	0.00025	A	23
Cz	Amount content of element in the sample, ug/g	9.338320	0.01411	0.00151		infinity
Ry	Measured ratio in the spike	0.009530	0.00006	0.00649	B	infinity
Ky	Mass bias correction factor for Ry	1.009371	0.00025	0.00025	A	23
mx	Mass of sample in blend b, g	0.004047191	4.10347E-07	0.00010		infinity
my	Mass of spike in blend b, g	0.55215	0.00002	0.00004	B	infinity
m'y	Mass of spike in blend b', g	0.48306	0.00002	0.00004	B	infinity
mz	Mass of primary standard in blend b', g	1.05224	0.00002	0.00002	B	infinity
w	Dry mass correction	0.998749	0.00001	0.00001		infinity
G	Digestion correction factor	1.000000	0.002000	0.00200	B	infinity
B	Blank correction factor	1.00000	0.002000	0.00200	B	infinity

<b>Cx</b>	<b>Cx</b>	<b>2568.892365</b>
<b>uc</b>	<b>uc</b>	<b>19.574600</b>
<b>veff</b>	<b>veff</b>	<b>infinity</b>
<b>k</b>	<b>k</b>	<b>2</b>
<b>U</b>	<b>U</b>	<b>39.149200</b>
<b>REU</b>	<b>REU(%)</b>	<b>1.52397</b>

## Appendix K

### Summary of the results for SARM 2, SARM 3 and SARM 4

Table 1: Summary of results for Ba in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	2568.892365	16.57507145	2568.892365	16.20503356	2568.892365	19.57460024
	std-spkB	2554.069191	15.6134572	2554.069191	15.53274898	2554.069191	19.32964303
	std-spkC	2545.961837	18.73401394	2545.961838	18.20090311	2545.961837	19.8922341
smp-spkB	std-spkA	2608.503064	18.92047248	2608.503064	18.88465264	2608.503064	20.20385939
	std-spkB	2593.451326	18.03357045	2593.451326	17.58172692	2593.451326	19.95542255
	std-spkC	2585.218962	20.86278531	2585.218962	20.41540336	2585.218962	20.51556167
smp-spkC	std-spkA	2596.728096	18.69608839	2596.728097	18.6543611	2596.728096	20.07031822
	std-spkB	2581.744303	17.80798537	2581.744303	17.34827638	2581.744303	19.82296841
	std-spkC	2573.549101	20.6449028	2573.549101	20.19154609	2573.549101	20.38199984
smp-spkD	std-spkA	2601.716176	17.31686059	2601.716176	17.22248494	2601.716176	19.8678515
	std-spkB	2586.7036	16.36815901	2586.7036	15.81193189	2586.7036	19.61980771
	std-spkC	2578.492655	19.43562761	2578.492656	18.90750987	2578.492655	20.18810284
smp-spkE	std-spkA	2611.150591	16.99036188	2611.150591	16.56250174	2611.150591	19.88686042
	std-spkB	2596.083576	16.01989847	2596.083576	15.08828539	2596.083576	19.6378637
	std-spkC	2587.842856	19.1662701	2587.842857	18.33387488	2587.842856	20.21004538
<b>Mean</b>		<b>2584.673847</b>		<b>2584.673847</b>		<b>2584.673847</b>	
<b>Standard deviation</b>		<b>18.48000908</b>		<b>18.48000909</b>		<b>18.48000908</b>	
<b>Combined standard uncertainty</b>		<b>18.76256245</b>		<b>18.36312291</b>		<b>20.50904722</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>37.5251249</b>		<b>36.72624582</b>		<b>41.01809443</b>	
<b>Relative uncertainty(%)</b>		<b>1.451832112</b>		<b>1.420923799</b>		<b>1.58697371</b>	

Table 2: Summary of results for Sr in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	60.92795502	0.79949085	60.92795503	0.827089187	60.92795502	0.882975257
	std-spkB	60.95234587	0.781334923	60.95234587	0.809933987	60.95234587	0.870968583
	std-spkC	60.81577045	0.776411875	60.81577045	0.805071497	60.81577045	0.868308865
smp-spkB	std-spkA	60.13813526	0.866903882	60.13813526	0.891802456	60.13813526	0.92406287
	std-spkB	60.16220992	0.850684052	60.16220993	0.876387201	60.16220992	0.912935452
	std-spkC	60.02740495	0.845943399	60.02740496	0.871689167	60.02740495	0.910231685
smp-spkC	std-spkA	59.24906267	0.786810928	59.24906268	0.813058589	59.24906267	0.858977864
	std-spkB	59.27278141	0.769377421	59.27278142	0.796566464	59.27278141	0.847306901
	std-spkC	59.13996938	0.764613763	59.13996939	0.791870266	59.13996938	0.844719991
smp-spkD	std-spkA	59.60855784	0.810521396	59.60855785	0.83614074	59.60855784	0.872416938
	std-spkB	59.6324205	0.793416097	59.63242051	0.819930407	59.6324205	0.86079404
	std-spkC	59.49880262	0.788659114	59.49880263	0.815242136	59.49880262	0.858179452
smp-spkE	std-spkA	59.74289145	0.799650759	59.74289146	0.825698872	59.74289145	0.865757098
	std-spkB	59.76680789	0.782218204	59.76680789	0.809194424	59.76680789	0.853983312
	std-spkC	59.63288889	0.777429696	59.6328889	0.804478788	59.63288889	0.851375391
<b>Mean</b>		<b>59.90453361</b>		<b>59.90453361</b>		<b>59.90453361</b>	
<b>Standard deviation</b>		<b>0.595829696</b>		<b>0.595829696</b>		<b>0.595829696</b>	
<b>Combined standard uncertainty</b>		<b>0.814783911</b>		<b>0.840986291</b>		<b>0.885987446</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>1.629567821</b>		<b>1.681972581</b>		<b>1.771974893</b>	
<b>Relative uncertainty(%)</b>		<b>2.720274616</b>		<b>2.807755072</b>		<b>2.957997978</b>	



Table 3: Summary of results for Zn in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	8.683713307	0.18298093	8.683713308	0.181691787	8.683713307	0.16838273
	std-spkB	9.142124261	0.187980629	9.142124262	0.186674915	9.142124261	0.174257677
	std-spkC	9.15093464	0.207503759	9.150934641	0.205947212	9.15093464	0.188702768
smp-spkB	std-spkA	8.563769433	0.188742996	8.563769434	0.187535393	8.563769433	0.172066217
	std-spkB	9.015848581	0.19431775	9.015848582	0.193097765	9.015848581	0.178282749
	std-spkC	9.024537267	0.212779699	9.024537268	0.211311234	9.024537267	0.192063115
smp-spkC	std-spkA	8.595510819	0.189734779	8.59551082	0.180838555	8.595510819	0.171915139
	std-spkB	9.049265587	0.195352589	9.049265588	0.185849154	9.049265587	0.178099654
	std-spkC	9.057986477	0.213856265	9.057986478	0.204827909	9.057986477	0.191990389
smp-spkD	std-spkA	8.530386146	0.182776038	8.530386147	0.181436296	8.530386146	0.165532075
	std-spkB	8.980702999	0.187924884	8.980703001	0.186562843	8.980702999	0.171311981
	std-spkC	8.989357815	0.206806549	8.989357816	0.205206845	8.989357815	0.185492218
<b>Mean</b>		<b>8.898678111</b>		<b>8.898678112</b>		<b>8.898678111</b>	
<b>Standard deviation</b>		<b>0.233821714</b>		<b>0.233821714</b>		<b>0.233821714</b>	
<b>Combined standard uncertainty</b>		<b>0.207484108</b>		<b>0.20434583</b>		<b>0.190737649</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.414968216</b>		<b>0.408691661</b>		<b>0.381475298</b>	
<b>Relative uncertainty(%)</b>		<b>4.663256848</b>		<b>4.592723275</b>		<b>4.28687602</b>	

Table 4: Summary of results for Cu in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	16.57436679	0.152099722	16.57436668	0.150807746	16.57436679	0.500014407
	std-spkB	17.20080603	0.187958982	17.20080603	0.186272795	17.20080603	0.521801399
	std-spkC	17.15598068	0.155409439	17.15598068	0.154083263	17.15598068	0.517445086
smp-spkB	std-spkA	16.75885734	0.175973604	16.75885734	0.174867472	16.75885734	0.507720986
	std-spkB	17.39226951	0.209755357	17.39226951	0.20837878	17.39226951	0.529819159
	std-spkC	17.34694521	0.180359701	17.34694521	0.179385581	17.34694521	0.525421306
smp-spkC	std-spkA	16.83175708	0.162011887	16.83175708	0.160376901	16.83175708	0.507975657
	std-spkB	17.46792455	0.197503994	17.46792455	0.195655661	17.46792455	0.530107281
	std-spkC	17.42240309	0.165735101	17.42240309	0.164223373	17.42240309	0.525683959
smp-spkD	std-spkA	16.73272938	0.194466737	16.73272938	0.19349446	16.73272938	0.508107775
	std-spkB	17.36515403	0.226588583	17.36515403	0.225341984	17.36515403	0.530209335
	std-spkC	17.31990039	0.199678445	17.3199004	0.198827838	17.31990039	0.525822119
<b>Mean</b>		<b>17.13075784</b>		<b>17.13075784</b>		<b>17.13075784</b>	
<b>Standard deviation</b>		<b>0.317064976</b>		<b>0.317064976</b>		<b>0.317064976</b>	
<b>Combined standard uncertainty</b>		<b>0.206638537</b>		<b>0.205469938</b>		<b>0.527281407</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.413277074</b>		<b>0.410939876</b>		<b>1.054562814</b>	
<b>Relative uncertainty(%)</b>		<b>2.412485647</b>		<b>2.398842364</b>		<b>6.155961247</b>	

Table 5: Summary of results for Ni in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	2.385817676	0.057789727	2.385817676	0.057308973	2.385817676	0.058190043
	std-spkB	2.500887378	0.062027244	2.500887379	0.061502412	2.500887378	0.06215182
	std-spkC	2.500163388	0.060675134	2.500163388	0.060167192	2.500163388	0.061072555
smp-spkB	std-spkA	2.452783851	0.065502568	2.452783851	0.065041157	2.452783851	0.063946957
	std-spkB	2.57108338	0.070017097	2.57108338	0.069512451	2.57108338	0.068143525
	std-spkC	2.570339068	0.068749983	2.570339069	0.06826272	2.570339068	0.067101811
smp-spkC	std-spkA	2.440427699	0.061886865	2.440427699	0.061389905	2.440427699	0.061379738
	std-spkB	2.558131282	0.066290388	2.558131282	0.065749067	2.558131282	0.065486669
	std-spkC	2.55739072	0.064966266	2.55739072	0.064441899	2.55739072	0.064414372
smp-spkD	std-spkA	2.457925844	0.059276472	2.457925845	0.058735688	2.457925844	0.059672834
	std-spkB	2.576473376	0.063636316	2.576473376	0.063049708	2.576473376	0.063746443
	std-spkC	2.575727504	0.062237587	2.575727504	0.061667464	2.575727504	0.062629687
<b>Mean</b>		<b>2.512262597</b>		<b>2.512262597</b>		<b>2.512262597</b>	
<b>Standard deviation</b>		<b>0.065392955</b>		<b>0.065392955</b>		<b>0.065392955</b>	
<b>Combined standard uncertainty</b>		<b>0.066424202</b>		<b>0.065927844</b>		<b>0.065981407</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.132848405</b>		<b>0.131855688</b>		<b>0.131962814</b>	
<b>Relative uncertainty(%)</b>		<b>5.287998353</b>		<b>5.248483523</b>		<b>5.252747628</b>	

Table 6: Summary of results for Mo in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	0.848795962	0.011282869	0.848795962	0.011230954	0.848795962	0.042355716
	std-spkB	0.881831439	0.011831596	0.88183144	0.01174419	0.881831439	0.044010904
	std-spkC	0.777878207	0.010351398	0.777878207	0.010344631	0.777878207	0.03881133
smp-spkB	std-spkA	0.873092435	0.008901954	0.873092435	0.008864731	0.873092435	0.04315825
	std-spkB	0.907073541	0.009394937	0.907073541	0.009253269	0.907073541	0.04484493
	std-spkC	0.800144685	0.008173182	0.800144686	0.008141951	0.800144685	0.0395466
smp-spkC	std-spkA	0.865448961	0.010810303	0.865448961	0.010784918	0.865448961	0.043044606
	std-spkB	0.793139831	0.009919197	0.793139831	0.009898178	0.793139831	0.039442536
	std-spkC	0.89913258	0.011349914	0.89913258	0.01123988	0.89913258	0.04472676
smp-spkD	std-spkA	0.781648866	0.011236616	0.781648866	0.011225811	0.781648866	0.039120954
	std-spkB	0.812070952	0.011767351	0.812070952	0.011690316	0.812070952	0.040649697
	std-spkC	0.716341319	0.010307298	0.716341319	0.010299164	0.716341319	0.035847288
<b>Mean</b>		<b>0.829716565</b>		<b>0.829716565</b>		<b>0.829716565</b>	
<b>Standard deviation</b>		<b>0.058322244</b>		<b>0.058322244</b>		<b>0.058322244</b>	
<b>Combined standard uncertainty</b>		<b>0.019843727</b>		<b>0.019816727</b>		<b>0.044677842</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.039687454</b>		<b>0.039633454</b>		<b>0.089355685</b>	
<b>Relative uncertainty(%)</b>		<b>4.783254398</b>		<b>4.776746143</b>		<b>10.76942281</b>	

Table 7: Summary of results for Cd in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	0.018152426	0.001133372	0.018152426	0.001123386	0.018152426	0.001098816
	std-spkB	0.018944023	0.001185655	0.018944023	0.001175198	0.018944023	0.001148262
	std-spkC	0.018991044	0.001185954	0.018991044	0.001175503	0.018991044	0.001185954
smp-spkB	std-spkA	0.018365148	0.001088237	0.018365148	0.001077526	0.018365148	0.001067058
	std-spkB	0.019166022	0.00113874	0.019166022	0.001127527	0.019166022	0.001115201
	std-spkC	0.019213594	0.001138749	0.019213594	0.001127539	0.019213594	0.001138749
smp-spkC	std-spkA	0.016652815	0.000982824	0.016652815	0.000973083	0.016652815	0.000964857
	std-spkB	0.017379017	0.001028456	0.017379017	0.00101826	0.017379017	0.001008397
	std-spkC	0.017422153	0.001028444	0.017422153	0.00101825	0.017422153	0.001028444
smp-spkD	std-spkA	0.017414202	0.001123824	0.017414202	0.001114493	0.017414202	0.001082289
	std-spkB	0.018173606	0.001175485	0.018173606	0.001165713	0.018173606	0.001130914
	std-spkC	0.018218715	0.001175949	0.018218715	0.001166183	0.018218715	0.001175949
<b>Mean</b>		<b>0.018174397</b>		<b>0.018174397</b>		<b>0.018174397</b>	
<b>Standard deviation</b>		<b>0.000823128</b>		<b>0.000823128</b>		<b>0.000823128</b>	
<b>Combined standard uncertainty</b>		<b>0.001142404</b>		<b>0.00113239</b>		<b>0.001122781</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.002284808</b>		<b>0.002264781</b>		<b>0.002245562</b>	
<b>Relative uncertainty(%)</b>		<b>12.57157352</b>		<b>12.46138131</b>		<b>12.3556358</b>	



Table 8: Summary of results for Pb in SARM 2

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	1.779271776	0.0124501	1.779271776	0.014813577	1.779271776	0.012464852
	std-spkB	1.867277958	0.01049398	1.867277958	0.013501605	1.867277958	0.012433491
	std-spkC	1.860544145	0.010456223	1.860544145	0.013452982	1.860544145	0.01238865
smp-spkB	std-spkA	1.763723075	0.011148497	1.763723075	0.014778459	1.763723075	0.011667758
	std-spkB	1.850960188	0.008794791	1.850960188	0.013497495	1.850960188	0.011562589
	std-spkC	1.844285221	0.008763177	1.844285221	0.013448886	1.844285221	0.011520888
smp-spkC	std-spkA	1.803219836	0.011539228	1.803219836	0.015215588	1.803219836	0.011979844
	std-spkB	1.892410535	0.00918778	1.892410535	0.013927662	1.892410535	0.011877963
	std-spkC	1.885586089	0.009154749	1.885586089	0.013877503	1.885586089	0.011835125
smp-spkD	std-spkA	1.731522429	0.011968488	1.731522429	0.015299268	1.731522429	0.011965151
	std-spkB	1.817166837	0.010018976	1.817166837	0.014196716	1.817166837	0.011917293
	std-spkC	1.810613736	0.009982932	1.810613736	0.01414558	1.810613736	0.011874313
<b>Mean</b>		<b>1.825548485</b>		<b>1.825548485</b>		<b>1.825548485</b>	
<b>Standard deviation</b>		<b>0.050122209</b>		<b>0.050122209</b>		<b>0.050122209</b>	
<b>Combined standard uncertainty</b>		<b>0.017818038</b>		<b>0.02026944</b>		<b>0.018772983</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.035636076</b>		<b>0.04053888</b>		<b>0.037545965</b>	
<b>Relative uncertainty(%)</b>		<b>1.952075006</b>		<b>2.220641115</b>		<b>2.056695041</b>	

Table 9: Summary of results for Ba in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	413.2315713	1.616311512	413.2315713	1.584471249	413.2315713	3.806802649
	std-spkB	413.5301135	1.676065583	413.5301135	1.643836041	413.5301135	3.813570305
	std-spkC	413.5213386	1.580304012	413.5213386	1.548133832	413.5213386	3.806648376
smp-spkB	std-spkA	412.7025844	1.614423097	412.7025844	1.582628239	412.7025844	3.697029468
	std-spkB	413.0007445	1.674094488	413.0007445	1.641910609	413.0007445	3.703828334
	std-spkC	412.9919808	1.578466068	412.9919808	1.546341962	412.9919808	3.696723699
smp-spkC	std-spkA	413.6494067	1.548574137	413.6494067	1.51323631	413.6494067	3.700260295
	std-spkB	413.9482508	1.61086788	413.9482508	1.575307388	413.9482508	3.707073763
	std-spkC	413.939467	1.510774192	413.939467	1.474959765	413.939467	3.699942943
<b>Mean</b>		<b>413.3906064</b>		<b>413.3906064</b>		<b>413.3906064</b>	
<b>Standard deviation</b>		<b>0.436650186</b>		<b>0.436650186</b>		<b>0.436650186</b>	
<b>Combined standard uncertainty</b>		<b>1.608505454</b>		<b>1.575467044</b>		<b>3.740058487</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>3.217010908</b>		<b>3.150934089</b>		<b>7.480116974</b>	
<b>Relative uncertainty (%)</b>		<b>0.77820126</b>		<b>0.762217148</b>		<b>1.809454994</b>	



Table 10: Summary of results for Sr in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	4740.01397	31.05688421	4740.01397	34.06310124	4740.01397	48.54291665
	std-spkB	4742.437394	27.66949036	4742.437394	31.07386773	4742.437394	47.0062788
	std-spkC	4721.671362	27.44699244	4721.671362	30.8495053	4721.671362	46.75460267
smp-spkB	std-spkA	4710.480311	31.75306316	4710.480311	34.6661365	4710.480311	48.67332778
	std-spkB	4712.888636	28.49308447	4712.888636	31.77274545	4712.888636	47.16073767
	std-spkC	4692.25199	28.27114464	4692.25199	31.54834546	4692.25199	46.90910344
smp-spkC	std-spkA	4726.725351	29.39801631	4726.725351	32.53693238	4726.725351	47.66548397
	std-spkB	4729.141982	25.81338375	4729.141982	29.40978124	4729.141982	46.10773358
	std-spkC	4708.434167	25.59230567	4708.434167	29.18821561	4708.434167	45.85935945
smp-spkD	std-spkA	4755.301505	33.78133279	4755.301505	36.58782372	4755.301505	49.99224488
	std-spkB	4757.732745	30.67797486	4757.732745	33.80644949	4757.732745	48.49311214
	std-spkC	4736.899738	30.45168185	4736.899738	33.57675218	4736.899738	48.23604527
<b>Mean</b>		<b>4727.831596</b>		<b>4727.831596</b>		<b>4727.831596</b>	
<b>Standard deviation</b>		<b>19.77156485</b>		<b>19.77156485</b>		<b>19.77156485</b>	
<b>Combined standard uncertainty</b>		<b>29.84531677</b>		<b>32.98928568</b>		<b>47.97145809</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>59.69063353</b>		<b>65.97857137</b>		<b>95.94291618</b>	
<b>Relative uncertainty (%)</b>		<b>1.262537219</b>		<b>1.395535565</b>		<b>2.029321778</b>	

Table 11: Summary of results for Zn in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	434.3954379	2.335415637	434.3954379	2.334210977	434.3954379	5.170798385
	std-spkB	435.5007432	2.442141413	435.5007432	2.439008041	435.5007432	5.215177226
	std-spkC	436.3033348	2.428868186	436.3033348	2.42606213	436.3033348	5.219249398
smp-spkB	std-spkA	426.1782647	2.738086461	426.1782647	2.738561339	426.1782647	5.226049754
	std-spkB	427.2626616	2.828311991	427.2626616	2.82713342	427.2626616	5.269086566
	std-spkC	428.0500711	2.818767523	428.0500711	2.817875652	428.0500711	5.273520366
smp-spkC	std-spkA	427.4152213	2.299342047	427.4152213	2.298159416	427.4152213	5.088262415
	std-spkB	428.5027657	2.404296448	428.5027657	2.401217066	428.5027657	5.131926231
	std-spkC	429.2924606	2.39124931	429.2924606	2.388491835	429.2924606	5.135934568
smp-spkD	std-spkA	427.9378925	1.860502197	427.9378925	1.857186818	427.9378925	4.968268821
	std-spkB	429.0267668	1.986699806	429.0267668	1.981219736	429.0267668	5.012441323
	std-spkC	429.8174273	1.969120974	429.8174273	1.963998281	429.8174273	5.016085755
<b>Mean</b>		<b>429.9735873</b>		<b>429.9735873</b>		<b>429.9735873</b>	
<b>Standard deviation</b>		<b>3.435891039</b>		<b>3.435891039</b>		<b>3.435891039</b>	
<b>Combined standard uncertainty</b>		<b>2.592239312</b>		<b>2.590128499</b>		<b>5.239595339</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>5.184478623</b>		<b>5.180256998</b>		<b>10.47919068</b>	
<b>Relative uncertainty (%)</b>		<b>1.205766767</b>		<b>1.204784933</b>		<b>2.437170791</b>	

Table 12: Summary of results for Cu in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	9.047151801	0.093587384	9.047151801	0.092947273	9.047151801	0.273660582
	std-spkB	9.069305113	0.100546366	9.069305113	0.099817071	9.069305113	0.275015292
	std-spkC	9.040867056	0.082335862	9.040867056	0.081845546	9.040867056	0.27246111
smp-spkB	std-spkA	11.29380202	0.119398036	11.29380202	0.118429647	11.29380202	0.341485702
	std-spkB	11.32145659	0.12792231	11.32145659	0.12685406	11.32145659	0.34317683
	std-spkC	11.2859566	0.105690602	11.2859566	0.104885071	11.2859566	0.339987972
smp-spkC	std-spkA	9.187556197	0.097226709	9.187556197	0.096617981	9.187556197	0.278126591
	std-spkB	9.210053311	0.104155294	9.210053311	0.103454313	9.210053311	0.279502316
	std-spkC	9.181173918	0.086087923	9.181173918	0.085634359	9.181173918	0.276909162
<b>Mean</b>		<b>9.848591401</b>		<b>9.848591401</b>		<b>9.848591401</b>	
<b>Standard deviation</b>		<b>1.090650037</b>		<b>1.090650037</b>		<b>1.090650037</b>	
<b>Combined standard uncertainty</b>		<b>0.377810633</b>		<b>0.377610664</b>		<b>0.470980697</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.755621266</b>		<b>0.755221329</b>		<b>0.941961395</b>	
<b>Relative uncertainty (%)</b>		<b>7.672379073</b>		<b>7.66831822</b>		<b>9.564427606</b>	

Table 13: Summary of results for Ni in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	2.077479504	0.039368724	2.077479504	0.03902681	2.077479504	0.038858694
	std-spkB	2.067695862	0.038680619	2.067695862	0.038346551	2.067695862	0.038269005
	std-spkC	2.036465065	0.038155486	2.036465065	0.037825712	2.036465065	0.03773873
smp-spkB	std-spkA	1.312582543	0.024602739	1.312582543	0.024397058	1.312582543	0.024592772
	std-spkB	1.306401092	0.024165728	1.306401092	0.023965132	1.306401092	0.024220439
	std-spkC	1.286669008	0.023838556	1.286669008	0.023640623	1.286669008	0.023884725
smp-spkC	std-spkA	1.282566959	0.022130184	1.282566959	0.021911211	1.282566959	0.022566599
	std-spkB	1.276526862	0.021684671	1.276526862	0.021470577	1.276526862	0.022193226
	std-spkC	1.257246004	0.021397394	1.257246004	0.021186219	1.257246004	0.021889393
<b>Mean</b>		<b>1.5448481</b>		<b>1.5448481</b>		<b>1.5448481</b>	
<b>Standard deviation</b>		<b>0.387252597</b>		<b>0.387252597</b>		<b>0.387252597</b>	
<b>Combined standard uncertainty</b>		<b>0.132347134</b>		<b>0.13229062</b>		<b>0.132332137</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.264694267</b>		<b>0.264581241</b>		<b>0.264664274</b>	
<b>Relative uncertainty (%)</b>		<b>17.13399961</b>		<b>17.12668325</b>		<b>17.13205813</b>	

Table 14: Summary of results for Mo in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	2.536625786	0.155782744	2.536625786	0.156316174	2.536625786	0.133533179
	std-spkB	2.534047345	0.156068	2.534047345	0.156589413	2.534047345	0.133484508
	std-spkC	2.47952539	0.153471286	2.47952539	0.153980977	2.47952539	0.130593329
smp-spkB	std-spkA	1.496088539	0.069446097	1.496088539	0.069123453	1.496088539	0.077978192
	std-spkB	1.494567788	0.06972101	1.494567788	0.069392761	1.494567788	0.077950791
	std-spkC	1.462411026	0.068812826	1.462411026	0.068495722	1.462411026	0.076262208
smp-spkC	std-spkA	1.46810651	0.072408574	1.46810651	0.072309011	1.46810651	0.076958883
	std-spkB	1.466614202	0.072654151	1.466614202	0.072548183	1.466614202	0.076931257
	std-spkC	1.435058883	0.071638179	1.435058883	0.071536491	1.435058883	0.075264888
<b>Mean</b>		<b>1.819227274</b>		<b>1.819227274</b>		<b>1.819227274</b>	
<b>Standard deviation</b>		<b>0.52368518</b>		<b>0.52368518</b>		<b>0.52368518</b>	
<b>Combined standard uncertainty</b>		<b>0.204531338</b>		<b>0.204614997</b>		<b>0.200673519</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.409062676</b>		<b>0.409229994</b>		<b>0.401347037</b>	
<b>Relative uncertainty (%)</b>		<b>22.48551801</b>		<b>22.49471516</b>		<b>22.06140171</b>	

Table 15: Summary of results for Pb in SARM 3

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	46.10283106	0.300879437	46.10283106	0.554373554	46.10283106	0.364815943
	std-spkB	46.1393789	0.300882	46.1393789	0.554684813	46.1393789	0.365105816
	std-spkC	46.14917985	0.310322468	46.14917985	0.559841015	46.14917985	0.367353562
smp-spkB	std-spkA	46.33530992	0.308378632	46.33530992	0.560490759	46.33530992	0.368053399
	std-spkB	46.37204207	0.308390162	46.37204207	0.560806985	46.37204207	0.368345839
	std-spkC	46.38189243	0.317702194	46.38189243	0.565960138	46.38189243	0.370596982
smp-spkC	std-spkA	45.61286683	0.306664767	45.61286683	0.553497799	45.61286683	0.363186467
	std-spkB	45.64902626	0.306680886	45.64902626	0.553810876	45.64902626	0.363475037
	std-spkC	45.65872304	0.315759045	45.65872304	0.558868553	45.65872304	0.365686162
<b>Mean</b>		<b>46.04458337</b>		<b>46.04458337</b>		<b>46.04458337</b>	
<b>Standard deviation</b>		<b>0.320269562</b>		<b>0.320269562</b>		<b>0.320269562</b>	
<b>Combined standard uncertainty</b>		<b>0.326405946</b>		<b>0.568171085</b>		<b>0.381538279</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.652811893</b>		<b>1.13634217</b>		<b>0.763076559</b>	
<b>Relative uncertainty (%)</b>		<b>1.417782169</b>		<b>2.467917151</b>		<b>1.657255866</b>	



Table 16: Summary of results for Ba in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	82.79975088	0.495569358	82.79975088	0.489498738	82.79975088	0.624998916
	std-spkB	82.83247942	0.4202034	82.83247942	0.414682733	82.83247942	0.615591462
	std-spkC	82.80196291	0.536325334	82.80196291	0.529931727	82.80196291	0.630880157
smp-spkB	std-spkA	82.85936536	0.536175294	82.85936536	0.531741685	82.85936536	0.631648091
	std-spkB	82.89211746	0.467332088	82.89211746	0.463722287	82.89211746	0.6223326
	std-spkC	82.86157898	0.574110287	82.86157898	0.569235888	82.86157898	0.637476662
smp-spkC	std-spkA	82.92621099	0.537889343	82.92621099	0.533406049	82.92621099	0.632095061
	std-spkB	82.95898952	0.469179985	82.95898952	0.465513596	82.95898952	0.622771067
	std-spkC	82.9284264	0.575770509	82.9284264	0.570849364	82.9284264	0.637928904
<b>Mean</b>		<b>82.87343132</b>		<b>82.87343132</b>		<b>82.87343132</b>	
<b>Standard deviation</b>		<b>0.057043248</b>		<b>0.057043248</b>		<b>0.057043248</b>	
<b>Combined standard uncertainty</b>		<b>0.515268109</b>		<b>0.510398901</b>		<b>0.628740816</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>1.030536217</b>		<b>1.020797802</b>		<b>1.257481632</b>	
<b>Relative uncertainty (%)</b>		<b>1.243506152</b>		<b>1.231755203</b>		<b>1.517351957</b>	



Table 17: Summary of results for Sr in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	259.3512596	1.511671527	259.3512596	1.69604061	259.3512596	2.583171662
	std-spkB	264.5747189	1.449003096	264.5747189	1.649447689	264.5747189	2.595252282
	std-spkC	265.175227	1.496710331	265.175227	1.691566629	265.175227	2.619952992
smp-spkB	std-spkA	258.6157705	2.497834384	258.6157705	2.614945787	258.6157705	3.098879739
	std-spkB	263.8244166	2.493208588	263.8244166	2.616254276	263.8244166	3.128261606
	std-spkC	264.4232218	2.524794379	264.4232218	2.646416777	264.4232218	3.150896346
smp-spkC	std-spkA	255.4676738	1.570311474	255.4676738	1.743665759	255.4676738	2.581049781
	std-spkB	260.6129158	1.515245577	260.6129158	1.702724738	260.6129158	2.59425155
	std-spkC	261.2044318	1.559967883	261.2044318	1.742695578	261.2044318	2.618399809
smp-spkD	std-spkA	255.7177251	2.493501616	255.7177251	1.745737708	255.7177251	2.583826072
	std-spkB	260.8680032	2.489930695	260.8680032	1.704780616	260.8680032	2.59704961
	std-spkC	261.4600982	2.520967169	261.4600982	1.744783382	261.4600982	2.621220283
<b>Mean</b>		<b>260.9412885</b>		<b>260.9412885</b>		<b>260.9412885</b>	
<b>Standard deviation</b>		<b>3.264105673</b>		<b>3.264105673</b>		<b>3.264105673</b>	
<b>Combined standard uncertainty</b>		<b>2.274442578</b>		<b>2.19419766</b>		<b>2.8980377</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>4.548885156</b>		<b>4.388395319</b>		<b>5.7960754</b>	
<b>Relative uncertainty (%)</b>		<b>1.743260019</b>		<b>1.681755825</b>		<b>2.221218203</b>	

Table 18: Summary of results for Zn in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	61.23076818	0.485087366	61.23076818	0.48380138	61.23076818	0.786756784
	std-spkB	61.48974794	0.440206075	61.48974794	0.439757951	61.48974794	0.771329694
	std-spkC	61.51417382	0.444057888	61.51417382	0.443541052	61.51417382	0.773048408
smp-spkB	std-spkA	61.33888373	0.474176983	61.33888373	0.472811525	61.33888373	0.783200153
	std-spkB	61.59832077	0.427870164	61.59832077	0.4273571	61.59832077	0.767603348
	std-spkC	61.62278978	0.431835482	61.62278978	0.431252161	61.62278978	0.769332437
smp-spkC	std-spkA	61.1355937	0.471999982	61.1355937	0.470634975	61.1355937	0.780348491
	std-spkB	61.39417091	0.425775326	61.39417091	0.425260559	61.39417091	0.76479596
	std-spkC	61.41855882	0.429733192	61.41855882	0.429148326	61.41855882	0.766519702
<b>Mean</b>		<b>61.41588974</b>		<b>61.41588974</b>		<b>61.41588974</b>	
<b>Standard deviation</b>		<b>0.162191292</b>		<b>0.162191292</b>		<b>0.162191292</b>	
<b>Combined standard uncertainty</b>		<b>0.451629441</b>		<b>0.45082158</b>		<b>0.775581821</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.903258881</b>		<b>0.90164316</b>		<b>1.551163642</b>	
<b>Relative uncertainty (%)</b>		<b>1.47072506</b>		<b>1.468094274</b>		<b>2.52567153</b>	



Table 19: Summary of results for Cu in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	10.5339098	0.104950118	10.5339098	0.104569695	10.5339098	0.31836011
	std-spkB	10.54030116	0.1069636	10.54030116	0.106549832	10.54030116	0.318752566
	std-spkC	10.61757964	0.108386848	10.61757964	0.10795794	10.61757964	0.321164914
smp-spkB	std-spkA	10.8087292	0.110576249	10.8087292	0.110235004	10.8087292	0.326929732
	std-spkB	10.81528731	0.112592674	10.81528731	0.112217087	10.81528731	0.327332423
	std-spkC	10.89458191	0.114057429	10.89458191	0.113666643	10.89458191	0.329809578
smp-spkC	std-spkA	10.57385182	0.095686328	10.57385182	0.095099851	10.57385182	0.318627751
	std-spkB	10.58026742	0.097895055	10.58026742	0.097276962	10.58026742	0.319021715
	std-spkC	10.65783892	0.099315896	10.65783892	0.098681643	10.65783892	0.321436544
<b>Mean</b>		<b>10.66914969</b>		<b>10.66914969</b>		<b>10.66914969</b>	
<b>Standard deviation</b>		<b>0.135240178</b>		<b>0.135240178</b>		<b>0.135240178</b>	
<b>Combined standard uncertainty</b>		<b>0.114992575</b>		<b>0.114572588</b>		<b>0.32554519</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.229985149</b>		<b>0.229145177</b>		<b>0.651090381</b>	
<b>Relative uncertainty (%)</b>		<b>2.155608985</b>		<b>2.147736076</b>		<b>6.10255175</b>	

Table 20: Summary of results for Ni in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	119.8126946	2.611188415	119.8126946	2.591935617	119.8126946	1.833909211
	std-spkB	119.2177532	2.196293431	119.2177532	2.182440055	119.2177532	1.580331041
	std-spkC	120.3036896	3.350320987	120.3036896	3.322147031	120.3036896	2.299825538
smp-spkB	std-spkA	118.1018312	2.44620502	118.1018312	2.425033602	118.1018312	1.725348821
	std-spkB	117.5153853	2.013014286	117.5153853	1.996884306	117.5153853	1.462355639
	std-spkC	118.5858151	3.203132481	118.5858151	3.173571161	118.5858151	2.201318186
smp-spkC	std-spkA	120.1626862	2.468605332	120.1626862	2.446681498	120.1626862	1.74056231
	std-spkB	119.5660069	2.023687848	119.5660069	2.006829735	119.5660069	1.470447294
	std-spkC	120.6551155	3.243433794	120.6551155	3.213053756	120.6551155	2.227980766
<b>Mean</b>		<b>119.3245531</b>		<b>119.3245531</b>		<b>119.3245531</b>	
<b>Standard deviation</b>		<b>1.063803955</b>		<b>1.063803955</b>		<b>1.063803955</b>	
<b>Combined standard uncertainty</b>		<b>2.687496359</b>		<b>2.66513985</b>		<b>1.897317714</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>5.374992718</b>		<b>5.3302797</b>		<b>3.794635428</b>	
<b>Relative uncertainty (%)</b>		<b>4.504515273</b>		<b>4.467043507</b>		<b>3.180096074</b>	



Table 21: Summary of results for Mo in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	0.854926489	0.023689395	0.854926489	0.02371742	0.854926489	0.044186979
	std-spkB	0.851828678	0.023598	0.851828678	0.023626188	0.851828678	0.044026874
	std-spkC	0.838398872	0.024661028	0.838398872	0.024660933	0.838398872	0.043566218
smp-spkB	std-spkA	0.894339297	0.019832053	0.894339297	0.019797267	0.894339297	0.045313744
	std-spkB	0.891098675	0.019753262	0.891098675	0.019718593	0.891098675	0.045149557
	std-spkC	0.877049743	0.021287922	0.877049743	0.02122372	0.877049743	0.044686844
smp-spkC	std-spkA	0.934364123	0.02527527	0.934364123	0.025300121	0.934364123	0.048100852
	std-spkB	0.930978472	0.025177751	0.930978472	0.02520252	0.930978472	0.047926566
	std-spkC	0.916300801	0.026384833	0.916300801	0.026378702	0.916300801	0.047427134
<b>Mean</b>		<b>0.88769835</b>		<b>0.88769835</b>		<b>0.88769835</b>	
<b>Standard deviation</b>		<b>0.035051904</b>		<b>0.035051904</b>		<b>0.035051904</b>	
<b>Combined standard uncertainty</b>		<b>0.026162871</b>		<b>0.026161486</b>		<b>0.047100624</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.052325743</b>		<b>0.052322973</b>		<b>0.094201247</b>	
<b>Relative uncertainty (%)</b>		<b>5.894540927</b>		<b>5.89422892</b>		<b>10.61185336</b>	

Table 22: Summary of results for Cd in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	0.086803128	0.001418944	0.086803128	0.001405457	0.086803128	0.001255951
	std-spkB	0.087053353	0.001371	0.087053353	0.001358388	0.087053353	0.001245607
	std-spkC	0.086893507	0.001401773	0.086893507	0.001388468	0.086893507	0.001252235
smp-spkB	std-spkA	0.087907242	0.001770207	0.087907242	0.0017597	0.087907242	0.001524764
	std-spkB	0.08816065	0.001733101	0.08816065	0.001723167	0.08816065	0.001517382
	std-spkC	0.087998769	0.001756754	0.087998769	0.001746452	0.087998769	0.00152211
smp-spkC	std-spkA	0.088530371	0.001446862	0.088530371	0.001433032	0.088530371	0.001279569
	std-spkB	0.088785575	0.001398323	0.088785575	0.001385011	0.088785575	0.001268999
	std-spkC	0.088622547	0.001429345	0.088622547	0.0014157	0.088622547	0.001275772
<b>Mean</b>		<b>0.087861682</b>		<b>0.087861682</b>		<b>0.087861682</b>	
<b>Standard deviation</b>		<b>0.000766582</b>		<b>0.000766582</b>		<b>0.000766582</b>	
<b>Combined standard uncertainty</b>		<b>0.001554987</b>		<b>0.001543013</b>		<b>0.001378571</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.003109974</b>		<b>0.003086026</b>		<b>0.002757141</b>	
<b>Relative uncertainty (%)</b>		<b>3.539624619</b>		<b>3.512368944</b>		<b>3.138047193</b>	



Table 23: Summary of results for Pb in SARM 4

		Sensitivity coefficients		Numerical approximation		Power Law	
		Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>	Concentration mg.kg <sup>-1</sup>	Standard uncertainty (u <sub>c</sub> ) mg.kg <sup>-1</sup>
smp-spkA	std-spkA	2.096982064	0.01134865	2.096982064	0.019253317	2.096982064	0.017536015
	std-spkB	2.100595517	0.010440	2.100595517	0.010439881	2.100595517	0.017401983
	std-spkC	2.102394924	0.010748769	2.102394924	0.010748769	2.102394924	0.01746895
smp-spkB	std-spkA	2.079232349	0.012488613	2.079232349	0.01985553	2.079232349	0.01768207
	std-spkB	2.082815217	0.011687588	2.082815217	0.011687588	2.082815217	0.017552417
	std-spkC	2.084599394	0.011961805	2.084599394	0.011961805	2.084599394	0.0176182
smp-spkC	std-spkA	2.145120368	0.012773436	2.145120368	0.020412468	2.145120368	0.01818961
	std-spkB	2.148816773	0.011938941	2.148816773	0.011938941	2.148816773	0.018055274
	std-spkC	2.150657487	0.012224402	2.150657487	0.012224402	2.150657487	0.01812325
<b>Mean</b>		<b>2.110134899</b>		<b>2.110134899</b>		<b>2.110134899</b>	
<b>Standard deviation</b>		<b>0.029664055</b>		<b>0.029664055</b>		<b>0.029664055</b>	
<b>Combined standard uncertainty</b>		<b>0.015362509</b>		<b>0.017819288</b>		<b>0.020308488</b>	
<b>k</b>		<b>2</b>		<b>2</b>		<b>2</b>	
<b>Expanded uncertainty</b>		<b>0.030725018</b>		<b>0.035638576</b>		<b>0.040616976</b>	
<b>Relative uncertainty (%)</b>		<b>1.456068887</b>		<b>1.688924059</b>		<b>1.924852092</b>	





# Appendix L

## Publications from this work