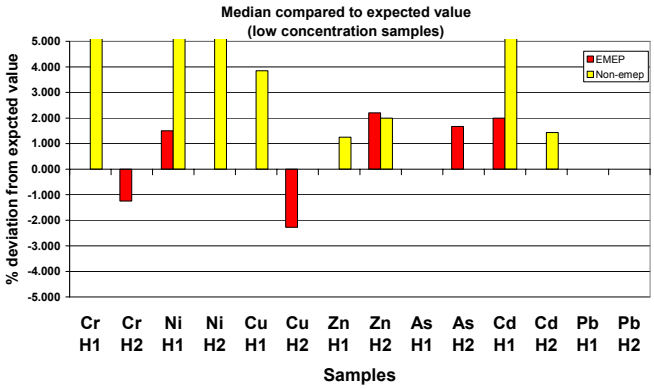
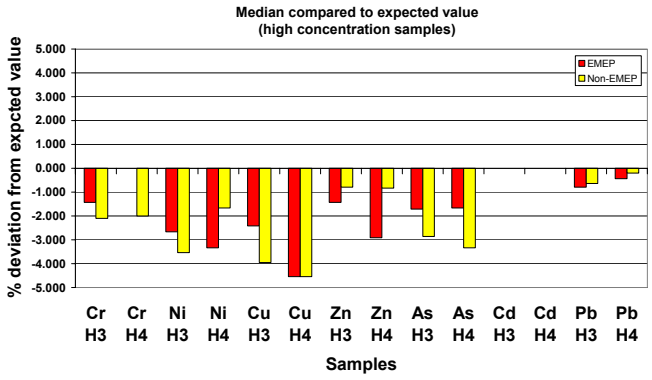
EMEP/CCC-Report 7/2003

EMEP Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe

Analytical intercomparison of heavy metals in precipitation 2002

Hilde Thelle Uggerud and Jan Erik Skjelmoen





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NILU : EMEP/CCC-Report 7/2003
REFERENCE : O-7729
DATE : JULY 2003

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1. Introduction

Heavy metals were included in the EMEP's monitoring programme in 1999. In 2001, 17 countries reported data to the heavy metal database. Since EMEP's measurement programme is based on individual national networks, different sampling and analytical methods are applied by the participating laboratories. In order to ensure data comparability, interlaboratory tests are organized by the Chemical Co-ordinating Centre (CCC) at the Norwegian Institute for Air Research. So far four intercomparisons have been arranged (Berg and Semb, 1995; Berg and Aas, 1999; Uggerud and Skjelmoen, 2000; Uggerud and Skjelmoen, 2001).

This report presents results from the fifth analytical intercomparison of heavy metals in precipitation, which was carried out during 2002. Seven heavy metals were included: Pb, Cd, Cu, Zn, As, Cr, and Ni.

2. Organization of the intercomparison

The samples for the fifth intercomparison were prepared and distributed to 41 laboratories. In addition to 17 EMEP laboratories, 13 laboratories connected to the ICP-forest measurement programme, 5 laboratories connected to WMO and 6 other laboratories also received samples. In accordance with the decision of the Steering Body of EMEP, the results are presented in such a way that the different laboratories are identified. Tables A.1.1a and A1.1b give the names of the participating laboratories together with the number used when presenting the results in tables and figures.

3. Intercomparison samples

The four synthetic precipitation samples distributed were made from multi-element standards traceable to NIST-standards. The multi-element standards were conserved with 2.5% HNO_3. The distributed synthetic precipitation samples contained Pb, Cd, Cu, Zn, As, Cr, and Ni in 0.5% HNO_3. Sample H1 and H2 contained concentrations similar to what is normally found in Southern Scandinavia. Sample H3 and H4 contained the elements in concentrations normally found in Central Europe.

All equipment in contact with the samples were soaked in 3% HNO_3 for at least 4 days. Preparation of the intercomparison samples was carried out in a clean room area.

4. Presentation of data

Tables A1.2-A1.8 present the reported results in decreasing order together with the laboratory numbers. The theoretical value, the number of results, the arithmetic mean value, the median, the standard deviation and the relative standard deviation are also given. In the first statistic run only values below detection limit were excluded. In the second run also outliers were excluded. The outliers were defined as values more than two standard deviations from the mean value in the first run.

In Figures A2.1-A2.7 the results are presented in plots showing the relative percentage deviation from expected value for each participating laboratory. There is one plot for every single sample.

The median calculated from the results reported from EMEP laboratories and other participating laboratories respectively, are compared to expected value in Figure A2.8.

A summary of the results is presented in Table A1.9. The results reported from each laboratory are divided in four percent intervals. The number of results reported by the laboratories in each per cent interval is also shown.

Table A1.10 gives information of the analytical techniques used by each laboratory.

5. Results

The analytical results from the intercomparison are presented in Figures A2.1-A2.8, Tables A1.2-A1.8 and Table A1.9. The results that were reported by the participating laboratories were generally in accordance with the theoretical values, with good agreement between the median from the second runs and the expected values.

5.1 Chromium (Cr)

A total of 31 laboratories reported values for chromium. Five laboratories reported values below detection limit for the low concentration samples. Six laboratories reported values from the low concentration samples that deviated more than 25% from expected value, whereas three laboratories reported values more than 15% from expected value for the high concentration samples. The relative standard deviations for the low concentration samples are 19.2% and 42.4%, when outliers are excluded. This is not as good as last year's result. For the high concentration samples, the standard deviations are 8.7% and 7.6%, when outliers are excluded. This is slightly better than last year's result.

5.2 Nickel (Ni)

Results from determination of nickel were obtained from 31 laboratories. Ten laboratories reported values below detection limit for the low concentration samples. Ten laboratories reported values for the low concentration samples that deviated more than 25% from expected value. For the high concentration samples,

five laboratories reported values that deviated more than 15% from expected value. The relative standard deviations for the low concentration samples are 49.6% and 49.0%, when outliers are excluded. This is about the same as in earlier intercomparisons. The relative standard deviations for the high concentration samples are 7.6% and 6.6%, when outliers are excluded. This is a slightly improvement compared to last year's results.

5.3 Copper (Cu)

A total of 31 laboratories reported values for copper. Three laboratories reported results from analysis of low concentration samples to be below detection limit. No such results were reported for the high concentration samples. Four laboratories reported values for the low concentration samples that deviated more than 25% from expected value. For high concentration samples, three laboratories reported values that deviated more than 15% from expected value. The relative standard deviations for the low concentration samples were 38.5% and 48.8% when outliers were excluded. This is not as good as last year's results. For the high concentration samples the relative standard deviation were 6.6% and 5.8%, which is slightly better than last year.

5.4 Zinc (Zn)

Results from determination of zinc were obtained from 31 laboratories. Five laboratories reported results from analysis of low concentration samples to be below detection limit. No such results were reported for the high concentration samples. Eight laboratories reported values for low concentration samples that deviated more than 25% from expected value, whereas two laboratories reported values more than 15% from expected value for the high concentration samples. The relative standard deviations for the low concentration samples are 17.0% and 28.0%, which is about the same result as last year. For the high concentration samples the relative standard deviation are 5.9% and 4.6%, which is a marked improvement compared to last year's results.

5.5 Arsenic (As)

Results from determination of arsenic were obtained from 23 laboratories. Five laboratories reported altogether eight values below detection limits for the two low concentration samples. All the reported values for the low concentration samples were within 25% deviation from expected value. For high concentration samples, six laboratories reported values that deviated more than 15% from expected value. The relative standard deviations for low concentration samples are 12.8% and 9.7%, when outliers are excluded. For the high concentration samples the relative standard deviations are 10.7% and 7.0%, when outliers are excluded. This is about the same as last year's results.

5.6 Cadmium (Cd)

Results from determination of cadmium were obtained from 31 laboratories. Eleven laboratories reported values for the low concentration samples to be below detection limit. Eight laboratories reported values for low concentration samples that deviated more than 25% from expected value, whereas only one laboratory reported values more than 15% from expected value for the high concentration

samples. The relative standard deviations for the low concentration samples are 24.6% and 24.5%, when outliers are excluded. This is slightly better than last years' results. For high concentration samples the relative standard deviations are 6.9% and 7.0%, which is about the same as reported last year.

5.7 Lead (Pb)

A total of 31 laboratories reported values for determination of lead. Five laboratories reported values for the low concentration samples to be below detection limit. Three laboratories reported values for the low concentration samples that deviated more than 25% from expected value. For high concentration samples, four laboratories reported values that deviated more than 15% from expected value. For the low concentration samples the relative standard deviation are 13.2% and 9.9%, when outliers are excluded. This is comparable to the results reported last year. For the high concentration samples, the relative standard deviations are 6.5% and 5.3%, which is slightly better than last year's results.

6. Conclusions

For all the samples analysed the deviation from theoretical values were calculated. The median deviations for the EMEP laboratories are lower than 2.3% and 5.0% for the low- and high concentration samples, respectively. This is the best result since laboratory intercomparisons on heavy metal started. Except for nickel, the median deviations for the other participating laboratories are below 18% for the low concentration samples. For the high concentration samples the median deviations are below 5%. This is an improvement compared to last year.

Figures that show the EMEP laboratories performance on determination of lead and cadmium from 1995 to 2002 can be seen in Aas et al. (2003).

7. References

Aas, W., Hjellbrekke A.-G. and Schaug, J. (2003) Data Quality 2001, quality assurance, and field comparisons. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Report 6/2003).

Berg, T., Hjellbrekke, A.-G. and Larsen, R. (2000) Heavy metals and POPs within Europe 1998. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Report 2/2000).

Berg, T. and Semb, A. (1995) Preliminary results from HELCOM-EMEP-PARCOM-AMAP analytical intercomparison of heavy metals in precipitation. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Note 1/95).

Berg, T. and Aas, W. (1999) Analytical intercomparison of heavy metals in precipitation 1999. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Report 8/2000).

Uggerud, H.Th. and Skjelmoen, J.E. (2001) Analytical intercomparison of heavy metals in precipitation 2000. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Report 12/2001).

Uggerud, H.Th. and Skjelmoen, J.E. (2002) Analytical intercomparison of heavy metals in precipitation 2001. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Report 2/2002).

Appendix 1

Tables

Table A1.1a: Participating laboratories in the EMEP network. The numbers in front are used in tables.

No.	Laboratory identification
1	Federal Environmental Agency, Austria
3	Czech Hydrometeorological Institute, Czech Republic
5	Finnish Meteorological Institute, Finland
6	Laboratories Wollf, France
7	IfE-Analytik GmbH, Germany
8	Umweltbundesamt, Germany
14	RIVM Laboratory of Inorganic Analytical Chemistry, The Netherlands
15	The Norwegian Institute for Air Research, Norway
16	Inst. Of Meteorology and Water Management, Poland
23	AEA Technology, National Environmental Techn. Centre, United Kingdom
26	Ontario Ministry of Environment, Canada
31	Slovak Hydrometeorological Institute, Slovakia
32	Atmospheric Pollution Research Laboratory, Lithuania
33	Latvian Hydrometeorological Agency, Latvia
34	Ministry of Health, Refit Saydam Hygiene Center, Turkey
38	Estonian Environmental Research Centre, Estonia
39	Institute of Environmental Protection, Poland

Table A1.1b: Participating laboratories outside the EMEP network. The number in front of the names is used in tables and figures.

No.	Laboratory identification
105	Universität des Saarlandes Umweltforsuchungszentrum, Germany
109	Institut f. Bondenkunde und Waldernährung der Universität, Germany
110	Thüringer Landesanstalt für Landwirtschaft (TLL), Germany
112	Niedersächsische Forstliche Versuchsanstalt (NVF), Germany
118	Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, Germany
119	Landesumweltamt (LUA)
121	Landesamt für Natur und Umwelt, Germany
125	Bayerisches Landesamt für Umweltschutz, Germany
127	Department of Chemistry, Jalan Sultan, Malaysia
129	Ecole Nationale d'Ingenieurs de Sfax, Tunisie
132	Comision Chilena De Energia Nuclear, Chile
137	UST Umwelt-Systemtechnik GmbH, Germany
141	Pollutants Chemical Analysis Center, Japan
142	EPLD, Centre de Lagor, France

Table A1.2: Analytical results for Cr in synthetic precipitation samples.

Cr
SAMPLE NO.: H1
THEORETICAL VALUE 0.600
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.687
MEDIAN: 0.600
STANDARD DEVIATON: 0.362
REL. ST. DEVIATION (%): 52.700

RUN 2:
NUMBER OF LABORATORIES: 24
ARITHMETIC MEAN VALUE: 0.590
MEDIAN: 0.600
STANDARD DEVIATON: 0.114
REL. ST. DEVIATION (%): 19.266

RESULTS IN DECREASING ORDER:

129	2.000 UNUSED	14	0.600	
142	< 2			
105	1.700 UNUSED	40	0.600	
112	< 1.5			
132	< 1.4			
137	< 1			
38	< 1			
121	0.760	110	0.600	
26	0.740	31	0.590	
125	0.726	15	0.580	
3	0.700	23	0.580	
39	0.700	109	0.570	
118	0.700	1	0.540	
32	0.640	16	0.500	
119	0.640	5	0.461	
8	0.620	33	0.400	
7	0.607	127	0.400	
6	0.600	34	0.300	

"UNUSED": DATA UNUSED IN RUN 2

Cr
SAMPLE NO.: H2
THEORETICAL VALUE 0.800
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.975
MEDIAN: 0.790
STANDARD DEVIATON: 0.712
REL. ST. DEVIATION (%): 73.016

RUN 2:
NUMBER OF LABORATORIES: 25
ARITHMETIC MEAN VALUE: 0.854
MEDIAN: 0.790
STANDARD DEVIATON: 0.362
REL. ST. DEVIATION (%): 42.421

RESULTS IN DECREASING ORDER:

129	4.000 UNUSED	15	0.790	
105	2.300	26	0.790	
142	< 2			
33	1.620	31	0.790	
112	< 1.5			
132	< 1.4			
137	< 1			
38	< 1			
14	1.000	32	0.790	
125	0.847	8	0.770	
119	0.840	1	0.750	
23	0.830	16	0.700	
3	0.820	39	0.700	
6	0.800	110	0.700	
40	0.800	5	0.669	
109	0.800	121	0.600	
118	0.800	127	0.600	
7	0.790	34	0.450	

"UNUSED": DATA UNUSED IN RUN 2

Cr
SAMPLE NO.: H3
THEORETICAL VALUE 9.500
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 8.967
MEDIAN: 9.300
STANDARD DEVIATON: 1.514
REL. ST. DEVIATION (%): 16.888

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 9.199
MEDIAN: 9.300
STANDARD DEVIATON: 0.802
REL. ST. DEVIATION (%): 8.716

RESULTS IN DECREASING ORDER:

105	10.900	110	9.300	
3	10.310	118	9.300	
6	9.900	1	9.290	
125	9.670	40	9.200	
31	9.660	127	9.100	
119	9.570	15	9.000	
14	9.500	102	9.000	
16	9.500	5	8.970	
34	9.500	7	8.910	
38	9.500	121	8.700	
26	9.420	137	8.400	
32	9.400	132	8.330	
112	9.400	33	8.310	
8	9.330	23	6.000	
39A	9.300	129	2.000 UNUSED	
109	9.300			

"UNUSED": DATA UNUSED IN RUN 2

Cr
SAMPLE NO.: H4
THEORETICAL VALUE 5.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 4.846
MEDIAN: 4.960
STANDARD DEVIATON: 0.647
REL. ST. DEVIATION (%): 13.346

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 4.941
MEDIAN: 4.980
STANDARD DEVIATON: 0.380
REL. ST. DEVIATION (%): 7.682

RESULTS IN DECREASING ORDER:

105	6.100	109	4.930	
32	5.600	1	4.900	
125	5.330	14	4.900	
6	5.300	118	4.900	
119	5.280	142	4.900	
3	5.110	7	4.850	
40	5.100	110	4.800	
38	5.060	121	4.700	
31	5.040	127	4.600	
15	5.000	132	4.590	
16	5.000	5	4.410	
26	5.000	137	4.400	
34	5.000	33	4.270	
39A	5.000	23	4.200	
112	5.000	129	2.000 UNUSED	
8	4.960			

"UNUSED": DATA UNUSED IN RUN 2

Table A1.3: Analytical results for Ni in synthetic precipitation samples.

Ni
SAMPLE NO.: H1
THEORETICAL VALUE 0.400
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.586
MEDIAN: 0.430
STANDARD DEVIATON: 0.409
REL. ST. DEVIATION (%): 69.726

RUN 2:
NUMBER OF LABORATORIES: 20
ARITHMETIC MEAN VALUE: 0.515
MEDIAN: 0.430
STANDARD DEVIATON: 0.256
REL. ST. DEVIATION (%): 49.595

RESULTS IN DECREASING ORDER:

142	< 5			
137	< 2			
129	2.000	UNUSED	23	0.430
127	< 2			
112	< 1.7			
105	1.400		7	0.406
132	< 1.14			
38	< 1			
39A	< 1			
119	< 0.9			
33	0.820		14	0.400
109	0.770		16	0.400
121	0.700		40	0.400
32	0.570		8	0.380
31	0.530		15	0.360
3	0.500		34	0.300
6	< 0.5			
110	< 0.5			
118	0.500		26	0.290
5	0.433		125	0.290
1	0.430			

"UNUSED": DATA UNUSED IN RUN 2

Ni
SAMPLE NO.: H2
THEORETICAL VALUE 0.600
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.808
MEDIAN: 0.600
STANDARD DEVIATON: 0.445
REL. ST. DEVIATION (%): 55.056

RUN 2:
NUMBER OF LABORATORIES: 22
ARITHMETIC MEAN VALUE: 0.754
MEDIAN: 0.600
STANDARD DEVIATON: 0.369
REL. ST. DEVIATION (%): 49.023

RESULTS IN DECREASING ORDER:

142	< 5			
137	< 2			
129	2.000	UNUSED	16	0.600
127	< 2			
112	< 1.7			
125	1.630		33	0.600
105	1.600		40	0.600
38	1.460		110	0.600
23	1.200		118	0.600
132	< 1.14			
39A	< 1			
119	< 0.9			
32	0.820		7	0.596
121	0.820		8	0.570
31	0.670		26	0.540
1	0.620		6	< 0.5
			5	0.486
3	0.600		34	0.470
14	0.600		109	0.300
15	0.600			

"UNUSED": DATA UNUSED IN RUN 2

Ni
SAMPLE NO.: H3
THEORETICAL VALUE 7.500
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 7.173
MEDIAN: 7.270
STANDARD DEVIATON: 0.651
REL. ST. DEVIATION (%): 9.078

RUN 2:
NUMBER OF LABORATORIES: 29
ARITHMETIC MEAN VALUE: 7.174
MEDIAN: 7.270
STANDARD DEVIATON: 0.551
REL. ST. DEVIATION (%): 7.686

RESULTS IN DECREASING ORDER:

121	8.600	UNUSED	1	7.200	
3	8.000		26	7.200	
39A	8.000		40	7.200	
15	7.800		110	7.200	
31	7.800		118	7.200	
109	7.800		127	7.000	
119	7.640		33	6.880	
7	7.530		32	6.700	
6	7.500		142	6.600	
16	7.500		5	6.510	
112	7.500		137	6.400	
8	7.410		38	6.320	
14	7.300		105	6.000	
23	7.300		129	6.000	
132	7.290		34	5.700	UNUSED
125	7.270				

"UNUSED": DATA UNUSED IN RUN 2

Ni
SAMPLE NO.: H4
THEORETICAL VALUE 9.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 8.661
MEDIAN: 8.700
STANDARD DEVIATON: 1.039
REL. ST. DEVIATION (%): 11.993

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 8.817
MEDIAN: 8.700
STANDARD DEVIATON: 0.585
REL. ST. DEVIATION (%): 6.633

RESULTS IN DECREASING ORDER:

11	10.400		23	8.700	
3	9.800		142	8.700	
39A	9.600		125	8.680	
15	9.300		33	8.670	
105	9.300		1	8.630	
119	9.290		110	8.600	
109	9.200		5	8.510	
31	9.190		118	8.500	
112	9.000		132	8.480	
127	9.000		6	8.400	
7	8.960		38	8.230	
8	8.960		32	8.100	
26	8.900		34	7.600	
40	8.900		137	7.500	
14	8.700		129	4.000	UNUSED
16	8.700				

"UNUSED": DATA UNUSED IN RUN 2

Table A1.4: Analytical results for Cu in synthetic precipitation samples.

Cu
SAMPLE NO.: H1
THEORETICAL VALUE 1.300
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 2.433
MEDIAN: 1.300
STANDARD DEVIATON: 5.672
REL. ST. DEVIATION (%): 233.165

RUN 2:
NUMBER OF LABORATORIES: 28
ARITHMETIC MEAN VALUE: 1.384
MEDIAN: 1.300
STANDARD DEVIATON: 0.533
REL. ST. DEVIATION (%): 38.539

RESULTS IN DECREASING ORDER:

05	31.800 UNUSED	15	1.300
29	4.000	39A	1.300
37 < 2			
40	1.700	110	1.300
19 < 1.68			
18	1.500	6	1.260
25	1.430	5	1.230
32	1.420	33	1.230
14	1.400	23	1.200
34	1.400	127	1.200
21	1.400	32	1.130
31	1.380	16	1.100
38	1.360	142	1.100
8	1.330	112	1.100
1	1.300	26	1.050
3	1.300	109	1.030
7	1.300		

"UNUSED": DATA UNUSED IN RUN 2

Cu
SAMPLE NO.: H2
THEORETICAL VALUE 1.100
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 6.390
MEDIAN: 1.090
STANDARD DEVIATON: 27.563
REL. ST. DEVIATION (%): 431.317

RUN 2:
NUMBER OF LABORATORIES: 27
ARITHMETIC MEAN VALUE: 1.183
MEDIAN: 1.090
STANDARD DEVIATON: 0.577
REL. ST. DEVIATION (%): 48.792

RESULTS IN DECREASING ORDER:

105	147.000 UNUSED	31	1.090
129	4.000	8	1.080
137 < 2			
119 < 1.68			
118	1.300	6	1.070
125	1.300	7	1.060
3	1.200	5	1.010
14	1.200	142 < 1	
		23	1.000
16	1.200	40	1.000
34	1.200	112	1.000
38	1.200	127	1.000
132	1.150	32	0.970
15	1.100	33	0.970
110	1.100	26	0.910
121	1.100	39A	0.900
1	1.090	109	0.730

"UNUSED": DATA UNUSED IN RUN 2

Cu
SAMPLE NO.: H3
THEORETICAL VALUE 6.200
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 7.295
MEDIAN: 6.000
STANDARD DEVIATON: 7.713
REL. ST. DEVIATION (%): 105.717

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 5.912
MEDIAN: 5.965
STANDARD DEVIATON: 0.392
REL. ST. DEVIATION (%): 6.638

RESULTS IN DECREASING ORDER:

105	48.800 UNUSED	1	5.930
14	6.400	109	5.910
6	6.370	23	5.900
125	6.330	34	5.900
31	6.210	40	5.900
3	6.200	142	5.900
8	6.200	118	5.900
15	6.200	38	5.860
26	6.200	5	5.790
110	6.200	109	5.670
127	6.200	132	5.360
7	6.140	112	5.300
32	6.100	33	5.290
121	6.100	39A	5.200
16	6.000	137	4.700
129	6.000		

"UNUSED": DATA UNUSED IN RUN 2

Cu
SAMPLE NO.: H4
THEORETICAL VALUE 11.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 11.998
MEDIAN: 10.500
STANDARD DEVIATON: 9.114
REL. ST. DEVIATION (%): 75.964

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 10.364
MEDIAN: 10.500
STANDARD DEVIATON: 0.607
REL. ST. DEVIATION (%): 5.861

RESULTS IN DECREASING ORDER:

105	61.000 UNUSED	109	10.500
5	11.200	121	10.500
125	11.200	26	10.300
31	11.120	118	10.300
8	11.100	40	10.200
14	11.000	132	10.100
16	11.000	129	10.000
15	10.900	23	9.900
110	10.800	102	9.900
119	10.740	6	9.890
32	10.700	33	9.780
3	10.600	142	9.600
127	10.600	34	9.400
1	10.500	39A	9.400
7	10.500	137	8.700
38	10.500		

"UNUSED": DATA UNUSED IN RUN 2

Table A1.5: Analytical results for Zn in synthetic precipitation samples.

Zn
SAMPLE NO.: H1
THEORETICAL VALUE 8.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 10.921
MEDIAN: 8.000
STANDARD DEVIATON: 10.975
REL. ST. DEVIATION (%): 100.493

RUN 2:
NUMBER OF LABORATORIES: 25
ARITHMETIC MEAN VALUE: 7.935
MEDIAN: 8.000
STANDARD DEVIATON: 1.350
REL. ST. DEVIATION (%): 17.015

RESULTS IN DECREASING ORDER:

105	54.500 UNUSED	31	8.000
129	42.000 UNUSED	32	8.000
119	< 30		
118	10.900	5	7.750
142	< 10		
137	< 10		
109	10.000	132	7.750
38	< 10		
125	9.970	1	7.660
6	9.230	33	7.500
8	8.800	110	7.400
23	8.500	127	7.400
26	8.260	15	7.200
7	8.250	34	7.000
40	8.200	39A	6.800
121	8.100	16	5.500
3	8.000	112	4.200
14	8.000		

"UNUSED": DATA UNUSED IN RUN 2

Zn
SAMPLE NO.: H2
THEORETICAL VALUE 5.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 8.526
MEDIAN: 5.155
STANDARD DEVIATON: 11.833
REL. ST. DEVIATION (%): 138.781

RUN 2:
NUMBER OF LABORATORIES: 24
ARITHMETIC MEAN VALUE: 5.320
MEDIAN: 5.055
STANDARD DEVIATON: 1.491
REL. ST. DEVIATION (%): 28.021

RESULTS IN DECREASING ORDER:

105	58.000 UNUSED	33	5.110
129	36.000 UNUSED	14	5.000
119	< 30		
142	< 10		
137	< 10		
109	< 10		
38	< 10		
34	9.200	16	5.000
125	8.210	31	5.000
118	7.500	40	5.000
6	6.290	15	4.900
8	5.900	1	4.780
23	5.800	5	4.680
26	5.620	39A	4.400
3	5.500	132	4.310
32	5.300	127	4.200
7	5.280	110	4.100
121	5.200	112	1.400

"UNUSED": DATA UNUSED IN RUN 2

Zn
SAMPLE NO.: H3
THEORETICAL VALUE105.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 108.785
MEDIAN: 103.330
STANDARD DEVIATON: 30.534
REL. ST. DEVIATION (%): 28.068

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 103.411
MEDIAN: 103.165
STANDARD DEVIATON: 6.196
REL. ST. DEVIATION (%): 5.992

RESULTS IN DECREASING ORDER:

105	270.000 UNUSED	31	103.000
26	112.000	119	103.000
129	112.000	118	102.400
8	111.100	5	102.000
127	110.500	34	101.500
6	109.700	33	101.000
3	109.000	39A	101.000
14	109.000	112	100.300
125	109.000	16	100.000
7	108.000	142	99.200
121	108.000	137	98.000
110	106.000	1	97.800
15	105.000	23	97.000
32	104.000	38	91.000
40	104.000	132	84.500
109	103.33		

"UNUSED": DATA UNUSED IN RUN 2

Zn
SAMPLE NO.: H4
THEORETICAL VALUE120.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 136.661
MEDIAN: 117.000
STANDARD DEVIATON: 109.321
REL. ST. DEVIATION (%): 79.994

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 117.050
MEDIAN: 116.750
STANDARD DEVIATON: 5.419
REL. ST. DEVIATION (%): 4.630

RESULTS IN DECREASING ORDER:

105	725.000 UNUSED	118	116.500
8	128.200	3	116.000
125	126.000	33	116.000
127	124.500	39A	116.000
7	123.000	112	116.000
26	123.000	6	115.400
14	120.000	5	115.000
15	120.000	142	113.400
16	120.000	129	112.000
32	120.000	34	111.500
40	120.000	1	111.000
109	120.000	137	111.000
110	120.000	23	110.000
121	120.000	132	107.000
119	118.000	38	105.000
31	117.000		

"UNUSED": DATA UNUSED IN RUN 2

Table A1.6: Analytical results for As in synthetic precipitation samples.

As
SAMPLE NO.: H1
THEORETICAL VALUE 0.400
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 23
ARITHMETIC MEAN VALUE: 0.402
MEDIAN: 0.400
STANDARD DEVIATON: 0.052
REL. ST. DEVIATION (%): 12.879

RUN 2:
NUMBER OF LABORATORIES: 18
ARITHMETIC MEAN VALUE: 0.402
MEDIAN: 0.400
STANDARD DEVIATON: 0.052
REL. ST. DEVIATION (%): 12.879

RESULTS IN DECREASING ORDER:
142 < 2
119 < 1.05
38 < 1
137 < 0.5

118	0.500	127	0.400	
110 < 0.5				
7	0.499	26	0.390	
33	0.460	125	0.381	
132	0.449	23	0.380	
14	0.430	15	0.370	
8	0.423	32	0.370	
1	0.400	31	0.330	
3	0.400	121	0.330	
6	0.400	5	0.323	

"UNUSED": DATA UNUSED IN RUN 2

As
SAMPLE NO.: H2
THEORETICAL VALUE 0.600
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 23
ARITHMETIC MEAN VALUE: 0.597
MEDIAN: 0.605
STANDARD DEVIATON: 0.067
REL. ST. DEVIATION (%): 11.202

RUN 2:
NUMBER OF LABORATORIES: 19
ARITHMETIC MEAN VALUE: 0.605
MEDIAN: 0.610
STANDARD DEVIATON: 0.059
REL. ST. DEVIATION (%): 9.725

RESULTS IN DECREASING ORDER:
42 < 2
19 < 1.05
38 < 1

18	0.700	1	0.600	
7	0.696	6	0.600	
32	0.690	110	0.600	
132	0.635	14	0.590	
31	0.630	125	0.588	
137	0.630	15	0.560	
3	0.620	121	0.520	
26	0.620	127	0.500	
8	0.612	5	0.486	
23	0.610	33	0.450	UNUSED

"UNUSED": DATA UNUSED IN RUN 2

As
SAMPLE NO.: H3
THEORETICAL VALUE 3.500
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 23
ARITHMETIC MEAN VALUE: 3.392
MEDIAN: 3.400
STANDARD DEVIATON: 0.576
REL. ST. DEVIATION (%): 16.993

RUN 2:
NUMBER OF LABORATORIES: 21
ARITHMETIC MEAN VALUE: 3.420
MEDIAN: 3.400
STANDARD DEVIATON: 0.365
REL. ST. DEVIATION (%): 10.664

RESULTS IN DECREASING ORDER:

32	4.600 UNUSED	118	3.400	
6	4.400	121	3.400	
7	3.810	137	3.400	
33	3.670	125	3.390	
8	3.610	26	3.340	
3	3.570	1	3.330	
10	3.500	119	3.320	
27	3.500	31	3.300	
14	3.480	5	2.650	
15	3.400	132	2.540	
23	3.400	38	1.610	UNUSED
42	3.400			

"UNUSED": DATA UNUSED IN RUN 2

As
SAMPLE NO.: H4
THEORETICAL VALUE 6.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 23
ARITHMETIC MEAN VALUE: 5.840
MEDIAN: 5.800
STANDARD DEVIATON: 0.589
REL. ST. DEVIATION (%): 10.093

RUN 2:
NUMBER OF LABORATORIES: 21
ARITHMETIC MEAN VALUE: 5.840
MEDIAN: 5.800
STANDARD DEVIATON: 0.413
REL. ST. DEVIATION (%): 7.072

RESULTS IN DECREASING ORDER:

6	7.300 UNUSED	23	5.800	
7	6.570	110	5.800	
142	6.500	121	5.800	
8	6.280	119	5.790	
127	6.200	1	5.690	
3	6.110	5	5.620	
31	6.080	137	5.600	
32	6.000	118	5.500	
14	5.900	33	4.990	
26	5.900	132	4.850	
125	5.860	38	4.390	UNUSED
15	5.800			

"UNUSED": DATA UNUSED IN RUN 2

Table A1.7: Analytical results for Cd in synthetic precipitation samples.

Cd
SAMPLE NO.: H1
THEORETICAL VALUE 0.050
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.068
MEDIAN: 0.052
STANDARD DEVIATON: 0.055
REL. ST. DEVIATION (%): 81.243

RUN 2:
NUMBER OF LABORATORIES: 20
ARITHMETIC MEAN VALUE: 0.056
MEDIAN: 0.052
STANDARD DEVIATON: 0.014
REL. ST. DEVIATION (%): 24.675

RESULTS IN DECREASING ORDER:

129 <	4		
142 <	1		
39A	0.300 UNUSED	1	0.051
105	0.100	14	0.051
112 <	0.5		
137 <	0.2		
132 <	0.2		
127 <	0.2		
110 <	0.1		
109 <	0.1		
6 <	0.1		
119 <	0.08		
32	0.080	16	0.050
141	0.071	31	0.050
33	0.060	121	0.049
118	0.060	38	0.048
8	0.056	5	0.048
23	0.055	3	0.047
26	0.055	15	0.042
125	0.055	34	0.040
7	0.052		

"UNUSED": DATA UNUSED IN RUN 2

Cd
SAMPLE NO.: H2
THEORETICAL VALUE 0.070
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.077
MEDIAN: 0.070
STANDARD DEVIATON: 0.024
REL. ST. DEVIATION (%): 31.540

RUN 2:
NUMBER OF LABORATORIES: 20
ARITHMETIC MEAN VALUE: 0.073
MEDIAN: 0.070
STANDARD DEVIATON: 0.018
REL. ST. DEVIATION (%): 24.501

RESULTS IN DECREASING ORDER:

129 <	4		
142 <	1		
112 <	0.5		
39A <	0.3		
137 <	0.2		
132 <	0.2		
127 <	0.2		
110 <	0.1		
6 <	0.1		
105	0.150 UNUSED	16	0.070
32	0.110	33	0.070
31	0.100	7	0.069
109	0.100	26	0.068
141	0.091	5	0.064
3	0.090	1	0.064
119 <	0.08		
14	0.073	121	0.064
15	0.072	34	0.060
23	0.071	38	0.055
125	0.071	118	0.030
8	0.070		

"UNUSED": DATA UNUSED IN RUN 2

Cd
SAMPLE NO.: H3
THEORETICAL VALUE 0.700
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.699
MEDIAN: 0.700
STANDARD DEVIATON: 0.061
REL. ST. DEVIATION (%): 8.684

RUN 2:
NUMBER OF LABORATORIES: 28
ARITHMETIC MEAN VALUE: 0.692
MEDIAN: 0.700
STANDARD DEVIATON: 0.048
REL. ST. DEVIATION (%): 6.900

RESULTS IN DECREASING ORDER:

129 <	4		
142 <	1		
105	0.900 UNUSED	39A	0.700
32	0.800	110	0.700
109	0.770	118	0.700
141	0.735	127	0.700
3	0.730	125	0.693
119	0.730	34	0.680
121	0.730	1	0.670
33	0.720	23	0.660
8	0.713	5	0.642
14	0.712	15	0.640
6	0.710	38	0.617
31	0.710	137	0.610
7	0.703	132	0.607
16	0.700	112	0.600
26	0.700		

"UNUSED": DATA UNUSED IN RUN 2

Cd
SAMPLE NO.: H4
THEORETICAL VALUE 0.800
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 0.790
MEDIAN: 0.800
STANDARD DEVIATON: 0.055
REL. ST. DEVIATION (%): 7.011

RUN 2:
NUMBER OF LABORATORIES: 29
ARITHMETIC MEAN VALUE: 0.790
MEDIAN: 0.800
STANDARD DEVIATON: 0.055
REL. ST. DEVIATION (%): 7.011

RESULTS IN DECREASING ORDER:

129 <	4		
142 <	1		
32	0.900	110	0.800
105	0.900	118	0.800
109	0.870	127	0.800
141	0.831	125	0.794
8	0.825	26	0.780
3	0.820	1	0.770
33	0.820	15	0.760
119	0.820	23	0.760
121	0.820	5	0.732
14	0.816	137	0.720
7	0.806	39A	0.700
6	0.800	112	0.700
16	0.800	38	0.695
31	0.800	132	0.683
34	0.800		

"UNUSED": DATA UNUSED IN RUN 2

Table A1.8: Analytical results for Pb in synthetic precipitation samples.

Pb
SAMPLE NO.: H1
THEORETICAL VALUE 1.400
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 1.463
MEDIAN: 1.400
STANDARD DEVIATON: 0.362
REL. ST. DEVIATION (%): 24.731

RUN 2:
NUMBER OF LABORATORIES: 25
ARITHMETIC MEAN VALUE: 1.402
MEDIAN: 1.400
STANDARD DEVIATON: 0.185
REL. ST. DEVIATION (%): 13.179

RESULTS IN DECREASING ORDER:

137	< 5		
132	< 5		
39A	< 5		
105	3.000 UNUSED	16	1.400
129	2.000	23	1.400
112	1.600	40	1.400
125	1.560	110	1.400
14	1.500	127	1.400
32	1.500	26	1.360
118	1.500	5	1.310
7	1.470	33	1.280
31	1.460	119	1.260
1	1.440	6	1.200
8	1.440	34	1.200
15	1.430	121	1.140
3	1.400	142	< 1
		38	< 1
		109	1.000

"UNUSED": DATA UNUSED IN RUN 2

Pb
SAMPLE NO.: H2
THEORETICAL VALUE 1.600
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 1.778
MEDIAN: 1.600
STANDARD DEVIATON: 0.686
REL. ST. DEVIATION (%): 38.593

RUN 2:
NUMBER OF LABORATORIES: 24
ARITHMETIC MEAN VALUE: 1.588
MEDIAN: 1.600
STANDARD DEVIATON: 0.158
REL. ST. DEVIATION (%): 9.952

RESULTS IN DECREASING ORDER:

137	< 5		
132	< 5		
39A	< 5		
105	4.100 UNUSED	16	1.600
129	4.000 UNUSED	26	1.600
109	2.000	50	1.600
125	1.960	8	1.580
32	1.700	121	1.580
40	1.700	23	1.500
112	1.700	34	1.500
7	1.620	127	1.500
31	1.610	5	1.470
1	1.600	119	1.410
3	1.600	6	1.400
14	1.600	33	1.390
15	1.600	118	1.300
		142	< 1
		38	< 1

"UNUSED": DATA UNUSED IN RUN 2

Pb
SAMPLE NO.: H3
THEORETICAL VALUE 47.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 45.994
MEDIAN: 46.500
STANDARD DEVIATON: 4.196
REL. ST. DEVIATION (%): 9.124

RUN 2:
NUMBER OF LABORATORIES: 29
ARITHMETIC MEAN VALUE: 46.052
MEDIAN: 46.500
STANDARD DEVIATON: 3.020
REL. ST. DEVIATION (%): 6.557

RESULTS IN DECREASING ORDER:

132	56.800 UNUSED	125	46.400	
109	50.330	31	46.380	
14	49.900	38	46.200	
119	49.600	129	46.000	
3	49.400	1	45.900	
118	49.300	110	45.000	
32	49.000	39A	44.000	
7	48.500	5	43.900	
40	48.000	121	43.900	
34	47.500	6	43.800	
112	47.200	23	42.000	
127	47.100	137	40.500	
15	47.000	16	40.000	
26	47.000	142	38.400	
8	46.800	105	33.500	UNUSED
33	46.500			

"UNUSED": DATA UNUSED IN RUN 2

Pb
SAMPLE NO.: H4
THEORETICAL VALUE 25.000
UNIT: ng/ml

RUN 1:
NUMBER OF LABORATORIES: 31
ARITHMETIC MEAN VALUE: 24.345
MEDIAN: 24.900
STANDARD DEVIATON: 1.517
REL. ST. DEVIATION (%): 6.230

RUN 2:
NUMBER OF LABORATORIES: 30
ARITHMETIC MEAN VALUE: 24.490
MEDIAN: 24.950
STANDARD DEVIATON: 1.307
REL. ST. DEVIATION (%): 5.335

RESULTS IN DECREASING ORDER:

119	26.500	127	24.900	
132	26.300	31	24.780	
14	25.800	1	24.500	
38	25.800	6	24.400	
118	25.500	33	24.300	
7	25.400	110	24.100	
109	25.330	15	24.000	
112	25.300	121	24.000	
3	25.200	5	23.000	
26	25.200	137	22.800	
8	25.100	23	22.000	
16	25.000	34	22.000	
32	25.000	129	22.000	
40	25.000	142	21.600	
105	25.000	39A	20.000	UNUSED
125	24.900			

"UNUSED": DATA UNUSED IN RUN 2

Table A1.9: Percentage deviation from theoretical concentration value.

Element and percent interval	**Lab. Identification** *The number in brackets are number of results reported in the particular percent interval by the laboratory*		
	EMEP	Other	
Cr			
0-5%			1(2), 3(2), 6(3), 7(3), 8(4), 14(3), 15(2), 16(2), 23(2), 26(3), 31(4), 32(2), 34(2), 39A(2), 39B(4), 109(4), 110(3), 118(3), 119(2), 125(1), 127(1)
5-15%			1(2), 3(2), 5(2), 6(1), 7(1), 15(2), 16(1), 32(2), 33(2), 39A(1), 105(1), 110(1), 119(2), 121(2), 125(2), 127(1), 132(2), 137(2)
15-25%			5(2), 14(1), 16(1), 23(1), 26(1), 39A(1), 105(1), 118(1), 121(1), 125(1), 127(1)
>25%			23(1), 33(2), 34(2), 105(2), 121(1), 127(1), 129(4)
Ni			
0-5%			1(3), 3(1), 7(4), 8(3), 14(4), 15(3), 16(4), 23(2), 26(2), 31(2), 33(2), 39B(4), 105(1), 109(2), 110(2), 112(2), 118(2), 119(2), 125(2), 127(1), 132(1), 142(1)
5-15%			1(1), 3(2), 5(3), 8(1), 15(1), 23(1), 26(1), 31(1), 32(2), 33(1), 39A(2), 118(1), 127(1), 132(1), 137(1), 142(1)
15-25%			3(1), 5(1), 34(4), 38(1), 105(1), 118(1), 121(2), 129(1), 137(1)
>25%			23(1), 26(1), 31(1), 32(2), 33(1), 105(2), 109(2), 121(2), 125(2), 129(3)
Cu			
0-5%			1(4), 3(3), 5(1), 6(3), 7(4), 8(4), 14(2), 15(4), 16(2), 23(1), 26(1), 31(3), 32(2), 34(1), 38(2), 39A(1), 39B(1), 109(1), 110(4), 118(1), 121(3), 125(1), 127(2), 129(1), 132(1), 142(1)
5-15%			3(19, 5(3), 6(1), 14(2), 16(1), 23(3), 26(1), 31(1), 32(2), 33(4), 34(3), 38(2), 39A(1), 39B(2), 109(1), 112(3), 118(1), 121(1), 125(1), 127(2), 129(1), 132(3), 142(1)
15-25%			16(1), 26(2), 39A(2), 109(1), 112(1), 118(2), 125(1), 142(1)
>25%			39B(1), 105(4), 109(1), 129(2)
Zn			
0-5%			1(2), 3(3), 5(3), 6(2), 7(3), 14(4), 15(3), 16(3), 26(2), 31(4), 32(3), 33(3), 34(1), 39A(2), 39B(4), 109(2), 110(2), 112(2), 118(2), 119(2), 121(4), 125(1), 127(1), 132(1)
5-15%			1(2), 3(1), 5(1), 7(1), 8(3), 15(1), 23(3), 26(2), 31(4), 32(3), 33(1), 34(2), 38(2), 39A(2), 110(1), 129(2), 137(2), 142(2)
15-25%			6(1), 8(1), 23(1), 110(1), 125(1), 127(1), 132(1)
>25%			6(1), 16(1), 34(1), 105(4), 109(1), 112(2), 118(2), 125(1), 129(2)
As			
0-5%	11	7	1(3), 3(4), 6(2), 8(3), 14(3), 15(2), 23(3), 26(4), 31(1), 32(1), 33(1), 110(3), 118(1), 119(1), 121(2), 127(3), 137(1), 142(1)
5-15%	9	6	1(1), 5(1), 7(2), 8(1), 14(1), 15(2), 23(1), 31(2), 32(1), 118(1), 119(1), 121(1), 132(2),137(2), 142(1)
15-25%	7	4	5(3), 6(1), 7(1), 16(1), 31(1), 32(1), 33(3), 118(2), 121(1), 127(1), 132(1)
>25%	3	1	6(1), 32(1), 38(1), 132(1)
Cd			
0-5%	16	7	1(3), 3(2), 5(1), 6(2), 7(4), 8(3), 16(4), 14(4), 15(1), 23(1), 26(3), 31(3), 33(3), 34(2), 38(1), 39A(1), 110(2), 118(2), 119(2), 121(3), 125(3), 127(2), 141(1)
5-15%	11	8	1(1), 3(1), 5(4), 8(1), 15(2), 23(3), 26(1), 32(2), 34(1), 38(2), 39A(1), 105(1), 109(2), 112(2), 121(1), 125(1), 132(2), 137(2), 141(1)
15-25%	4	1	15(1) 33(1), 34(1), 38(1), 118(1)
>25%	4	4	3(1), 31(1), 32(2), 39A(1), 105(3), 109(1), 118(1), 141(2)

Table A1.9, cont.

Element and percent interval	**Lab. Identification** *The number in brackets are number of results reported in the particular percent interval by the laboratory*		
	EMEP	Other	
Pb			
0-5%	16	8	1(4), 3(3), 6(1), 7(3), 8(4), 14(2), 15(4), 16(3), 23(1), 26(4), 31(4), 32(2), 33(2), 34(1), 38(2), 39B(3), 105(1), 109(1), 110(4), 112(2), 118(2), 121(2), 125(2), 129(1)
5-15%	11	11	5(4), 3(1), 6(3), 7(1), 14(2), 16(1), 23(3), 32(2), 33(2), 34(3), 39A(1), 109(1), 112(2), 118(1), 119(4), 121(1), 125(1), 127(1), 129(1), 132(1), 137(2), 142(1)
15-25%	1	6	39A(1), 109(1), 118(1), 121(1), 125(1), 132(1), 142(1)
>25%	0	3	105(3), 109(1), 129(2)

Table A1.10: Analytical techniques used at the participating laboratories for the different elements.

Lab. no.	Elements	Technique
1	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
3	Ni, Cd, Cu, Pb, Cr, As Zn	GF-AAS ICP-MS F-AAS
5	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
6	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
7	Cr, Ni, Cu, Zn, As, Cd, Pb Zn	GF-AAS F-AAS
8	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
14	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
15	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
16	Cr, Ni, Cu, Cd, Pb Zn	GF-AAS F-AAS
23	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
26	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
31	Cr, Ni, Cu, Cd, Pb, As Zn	GF-AAS F-AAS
32	Cr, Ni, Cu, Zn, As, Cd, Pb	GF-AAS
33	Cu, Cd, Pb Zn As	GF-AAS F-AAS HG-AAS
34	Ni, Cu	AAS
36	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
38	Cr, Ni, Cu, , Cd, Pb Zn	GF-AAS F-AAS
39A	Cr, Ni, Cu, Zn, Cd, Pb	UN-ICP-AES
39B	Cr, Ni, Cu, Zn, Pb	GF-AAS
105	Cr, NI, Cu, Zn, Cd, Pb	GF-AAS
109	Cr, Ni, Cu, Zn, Cd, Pb	GF-AAS
110	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
112	Cr, Ni, Cu, Zn, As, Cd, Pb	USN-ICP-MS
115	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
117	Cr, Ni, Cu , Zn As, Cd, Pb	USN-ICP-OES GF-AAS
118	Cu, Cd, Pb As ,Zn Cr, Ni	GF-AAS ICP-OES
119	Cr, Ni, Cu, As, Cd, Pb Zn	GF-AAS F-AAS
121	Cr, Ni, Cu, Cd, Pb Zn As	GF-AAS Voltametry HG-AAS
125	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS

Table A1.10, cont.

Lab. no.	Elements	Technique
127	Cr, Ni, Cu, Zn, As, Cd, Pb	ICP-MS
128	Cu, Cd, Pb As Zn	GF-AAS HG-AAS F-AAS
129	Cr, Ni, Cu, Zn, Cd, Pb	F-AAS (Polarized Zeeman)
132	Cr, Ni, Cu, Zn , Cd Pb As	USN-ICP-OES GF-AAS HG-AAS
134	Zn	ICP-OES
137	Cr, Cd, Pb Ni, Cu, Zn As	GF-AAS F-AAS HG-AAS
141	Cd	GF-AAS
142	Cr, Ni, Cu, As, Cd, Pb Zn	ICP-MS ICP-AES

Appendix 2

Figures

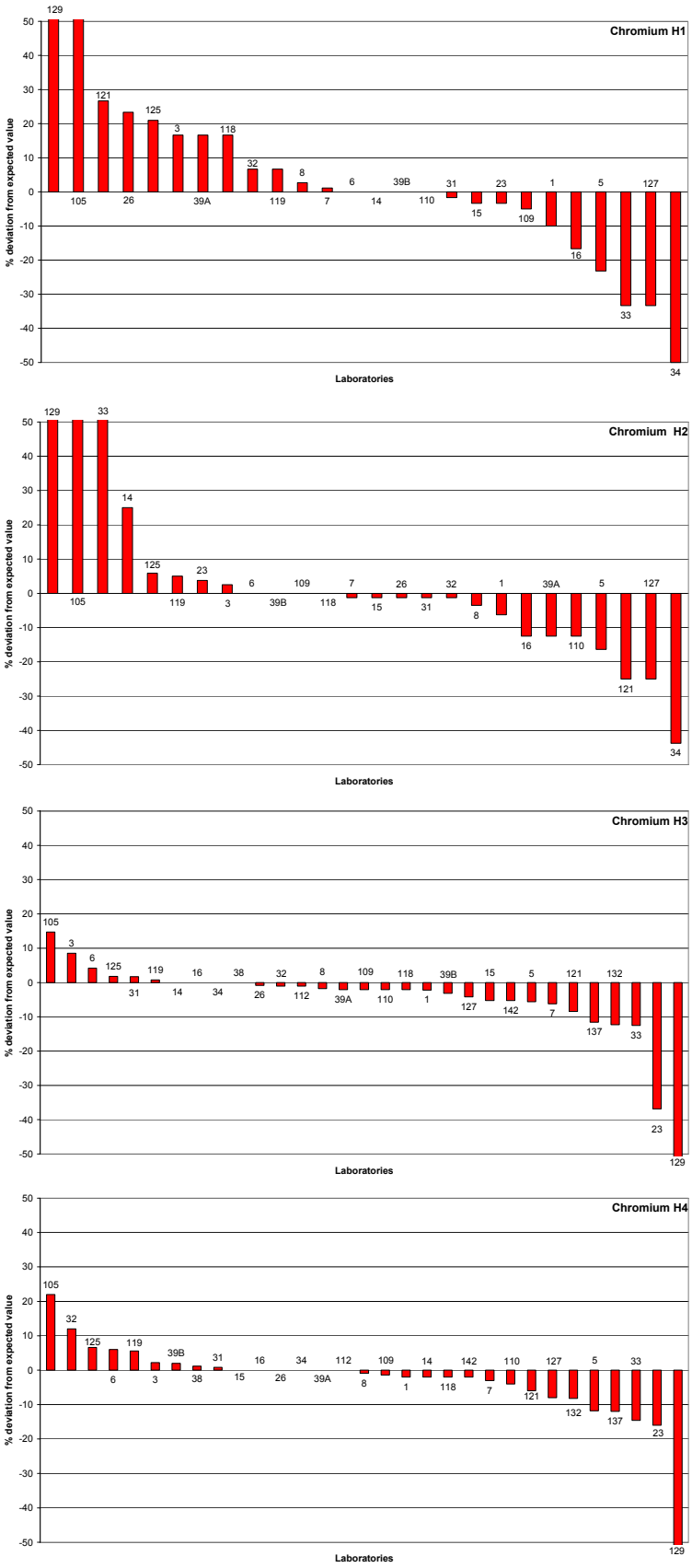


Figure A2.1: Results from determination of Cr.

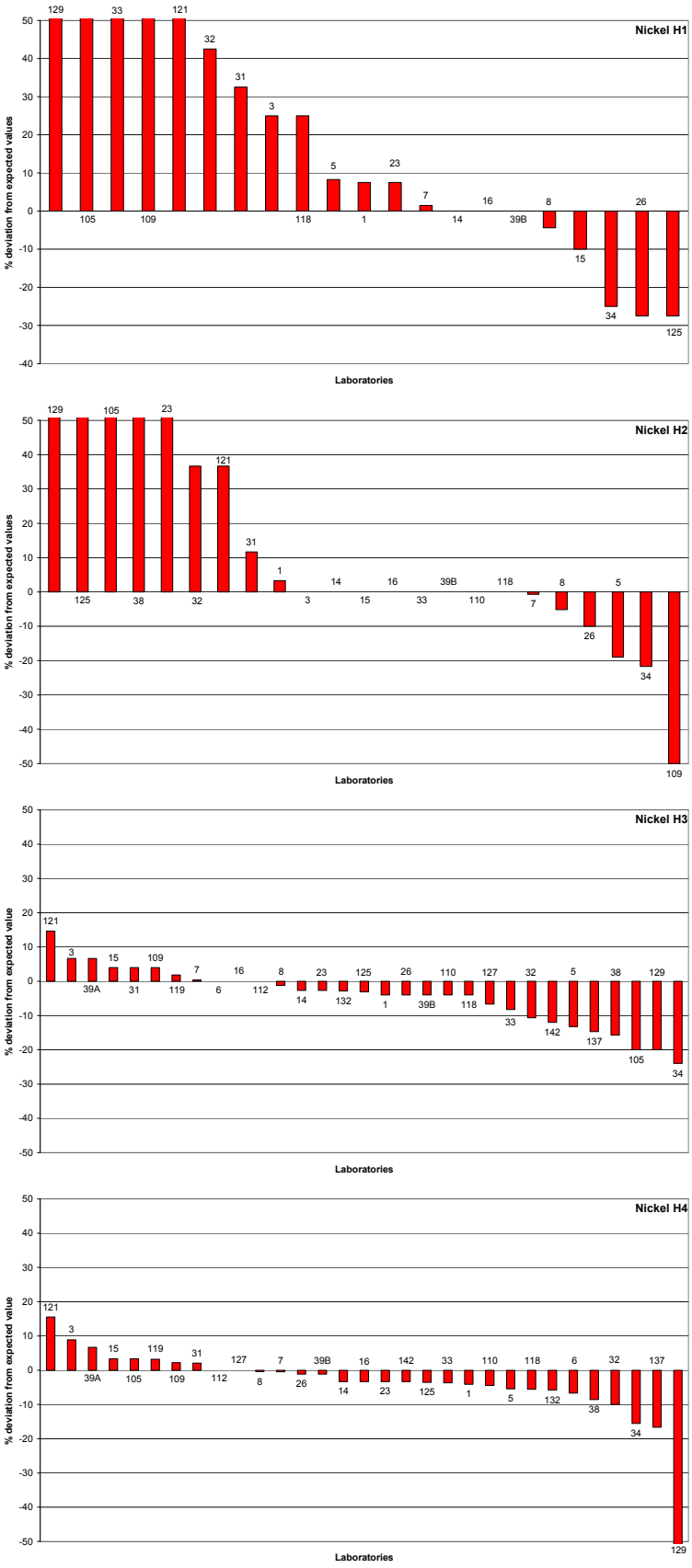


Figure A2.2: Results from determination of Ni.

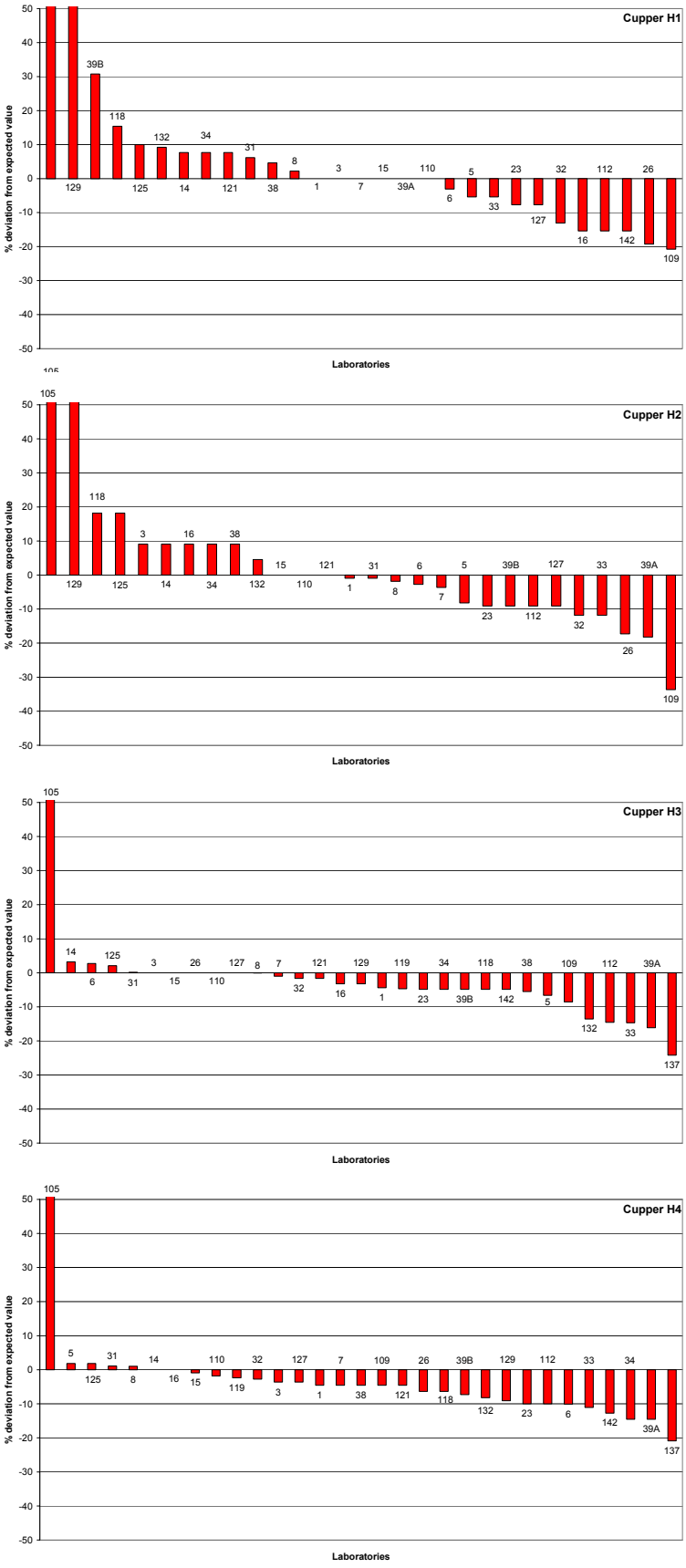


Figure A2.3: Results from determination of Cu.

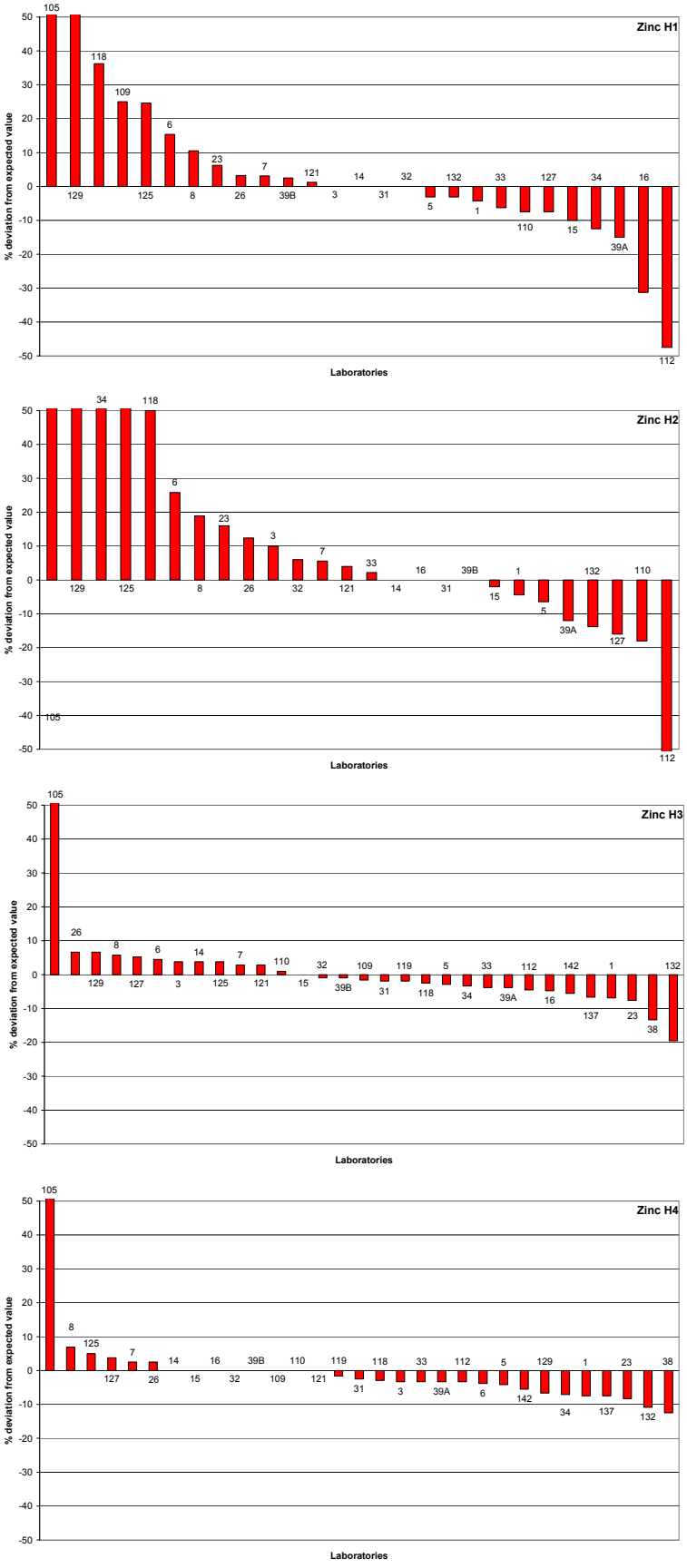


Figure A2.4: Results from determination of Zn.

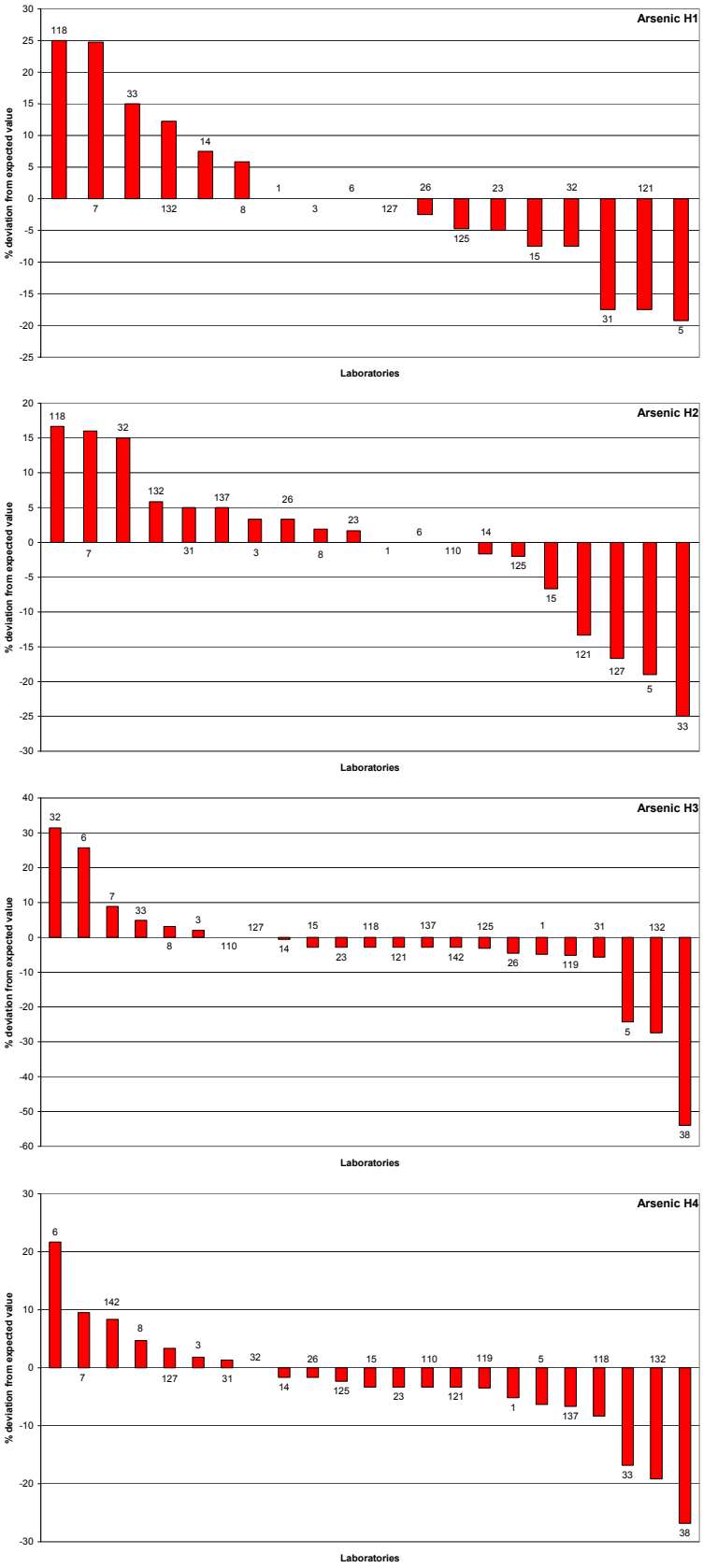


Figure A2.5: Results from determination of As.

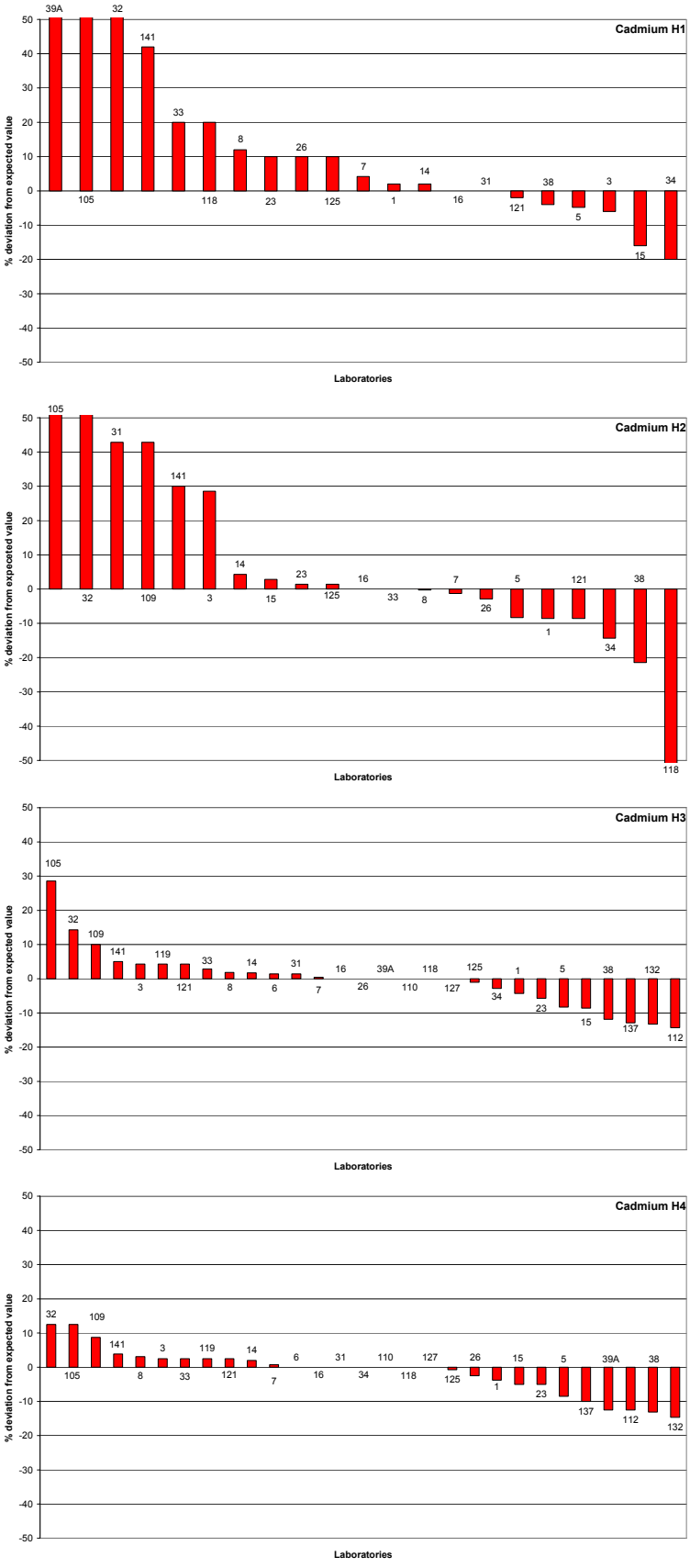


Figure A2.6: Results from determination of Cd.

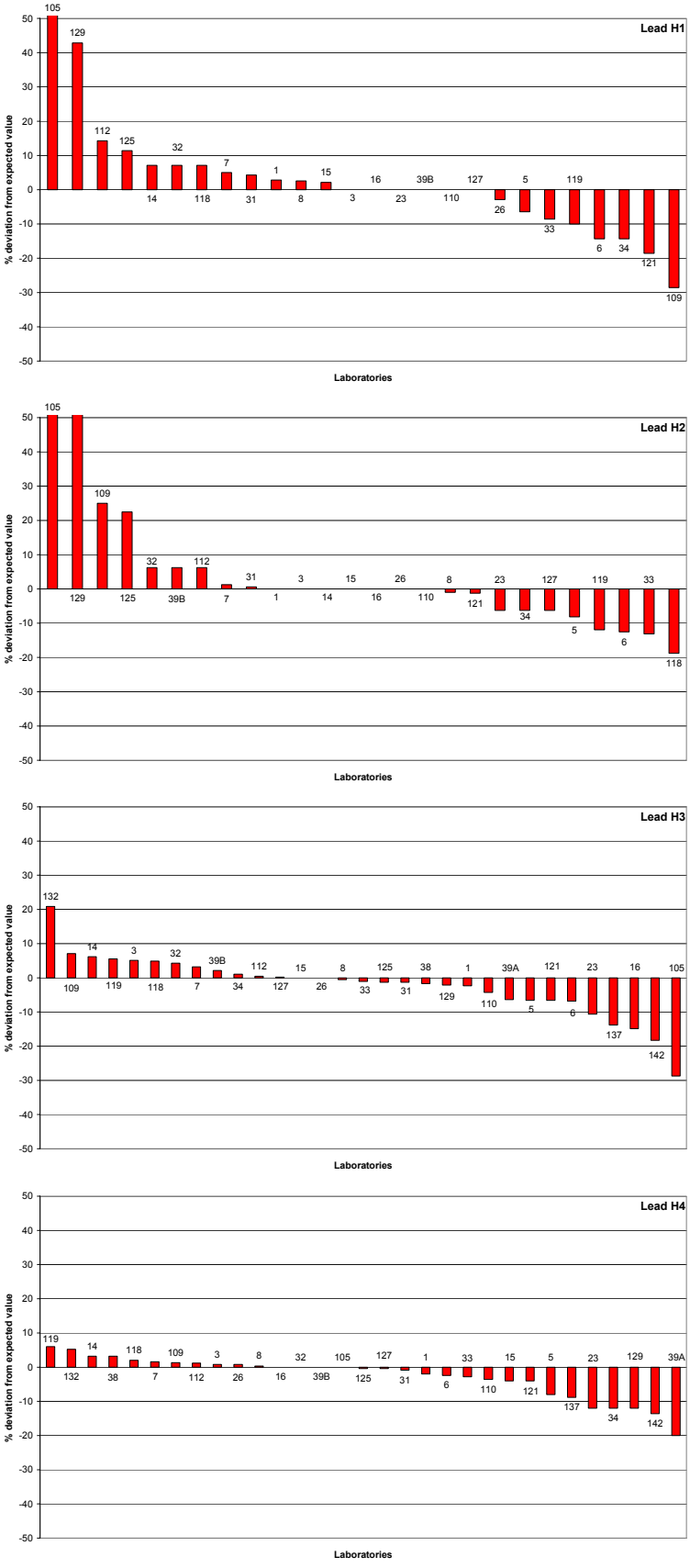
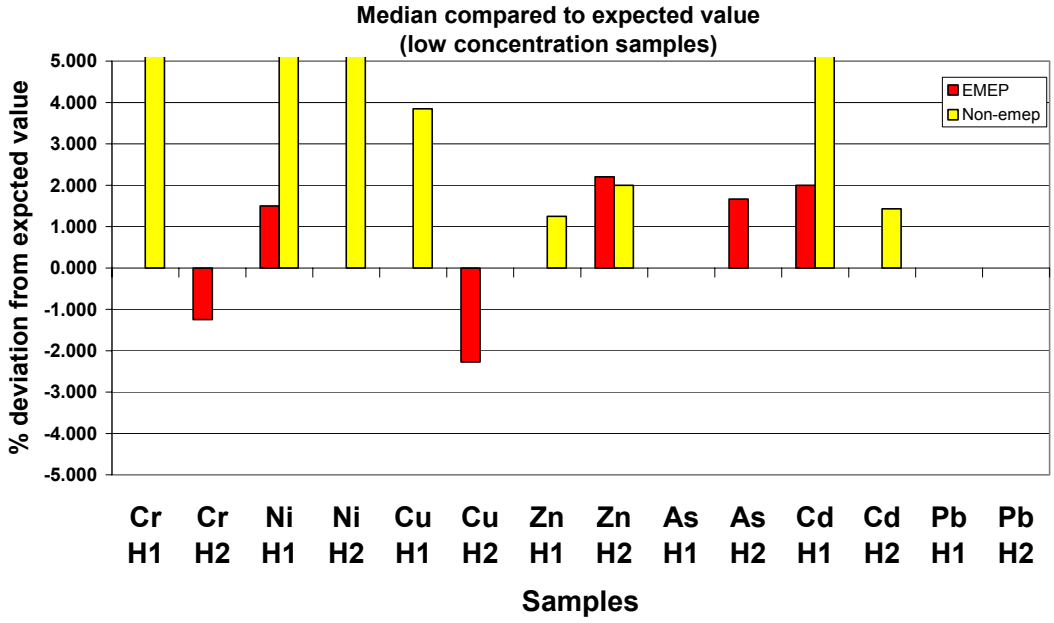


Figure A2.7: Results from determination of Pb.



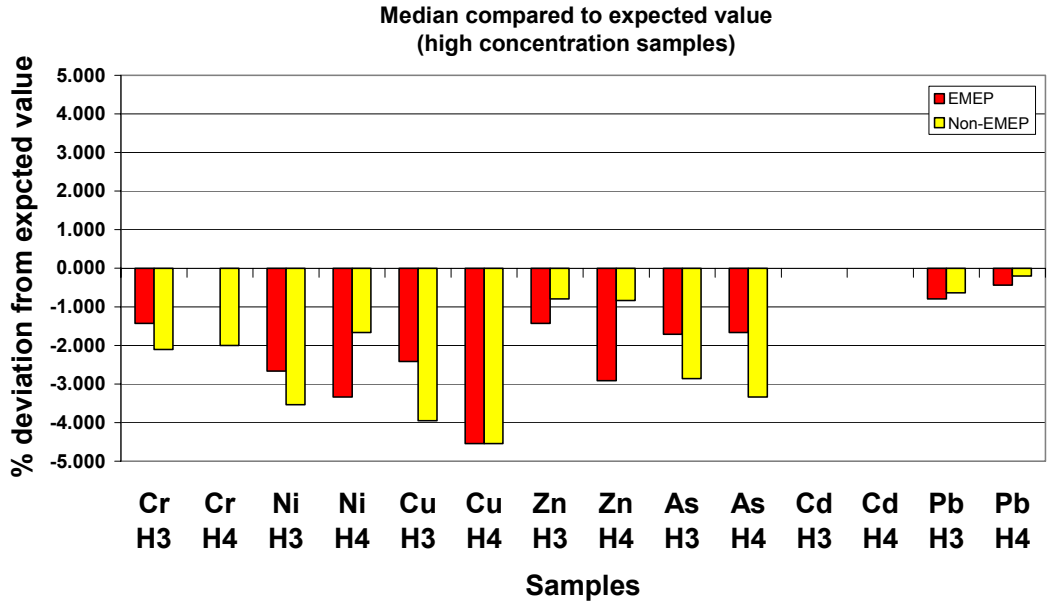


Figure A2.8: The median compared to theoretical value for low and high concentration samples, respectively.