*Report for the Project Titled "Monitoring of Air Toxic Particulate Pollutants from Heavily Trafficked New Jersey Turnpike: An Urban Community-Wide Project"*

*Funded by the USEPA: XA 97268501*

# Result of Targeted Trace Metals

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September 13, 2009

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# SUMMARY

To characterize the air concentrations of trace metals in particulate matter with diameter less than 2.5 μm (PM2.5) and their mass-size distributions derived from vehicle emissions, aerosol sampling was carried out near the heavily trafficked New Jersey Turnpike (NJTP) at East Rutherford, New Jersey from September 2007 to September 2008. Aerosol samples were collected by Partisol-FRM 2000 air samplers and MOUDI sampler and analyzed by ICPMS. Concentrations of ten trace metals (Al, Cd, Cr, Cu, Fe, Ni, Pb, Sc, V and Zn) in PM2.5 showed certain gradients as a function of distance away from the center of NJTP within 150 m. Seasonal concentration variations were identified in most trace metals: higher concentrations occurred in spring and summer. All measured trace metals showed higher concentrations on weekdays than on weekends. Two intensive samplings in winter and summer provided diurnal concentration variations of trace metals. In both seasons, most of trace metals were enriched in samples collected in the day time except for Cu, and this trend was stronger in winter. Results derived from MOUDI samples showed the particle-size distributions of the above mentioned trace metals associated with particulate matter in the ambient at this location that varied among trace metals. Crustal elements (Al, Fe, Sc) were primarily enriched in coarse-mode particles, with the concentrations of Al and Sc being higher in summer that in winter. The metals that showed bio-model size distributions include Cd, Cr, Cu, and Zn, with certain seasonal variations among them. A decreasing pattern was found for the size distributions of Ni and V. The size distributions of Pb were complex and its size distributions varied with seasons. In winter, it was accumulated in fine particles with higher concentrations in the 0.18-1.8μm size range. In summer, similar accumulation levels were observed for both the particles with size greater than 1.8μm and particles with size smaller than 1.8μm in diameter.

**TABLE OF CONTENT**

# 1. INTRODUCTION

A significant source of urban air pollution is motor vehicle emissions, as they generate many pollutants, including suspended particulate matter enriched with trace metals. The size distributions of particulate matter affect the toxicity of the trace metals it contains (Allen et al., 2001) and thus, their impacts on human health (Hinds, 1999). Trace metals have been found associated with fine particles, commonly referred to as PM2.5 (particulate matter with diameter equal to and less than 2.5 μm) (Gao et al., 2002), and these fine particles could come from vehicle exhaust (Ristovski et al., 2000). Therefore, it is important to quantify the size distributions of trace metals and their concentrations in PM2.5 from vehicle emissions. Zhu et al. (2002) found steep concentration gradients of black carbon within 150 m, decreasing from highway in Los Angeles, US. Similarly, aerosol mass concentrations were also found decreasing from highway in urban areas in Australia (Hitchins et al., 2000) and the Netherlands (Janssen et al., 2001). However, the concentration gradients of trace metals associated with PM2.5 have not been studied in high-traffic areas in New Jersey; little information is available on the particle-size distributions of trace elements in aerosols in the ambient air in this region.

# 2. OBJECTIVES

As part of the project entitled "Monitoring of Air Toxic Particulate Pollutants from Heavily Trafficked New Jersey Turnpike: An Urban Community-Wide Project" sponsored by the US EPA, air sampling was made at the side of the New Jersey Turnpike to characterize the concentrations of selected trace elements in aerosols in the ambient air heavily affected by traffic in New Jersey.

The objectives of this research are: (1) to measure the air concentrations of ten selected trace elements: aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), nickel (Ni), lead (Pb), scandium (Sc), vanadium (V), and zinc (Zn) associated with PM2.5 at three platforms away from the targeted highway; (2) to investigate the seasonal and diurnal variations of the above mentioned trace metals in PM2.5; (3) to characterize the particle-size distributions of these trace elements in aerosol particles in the ambient air.

## 3. METHODS

### 3.1 Sampling

Three sampling platforms were set up at a distance of 50, 100 and 150 m from the New Jersey Turn Pike, located at East Rutherford in New Jersey. For studying trace elements, three kinds of sampling were conducted during this study: (1) one-year collection of PM2.5 samples, (2) intensive collection of PM2.5 samples during summer and winter, and (3) collection of particle-size distributions in summer and winter. PM 2.5 sampling was made at each platform by a Partisol-FRM 2000 air sampler with a flow rate of 16.7 l/min (Rupprecht & Patashnick Co., Inc, NY) using 47 mm Teflon membrane filters. The 24-hour PM2.5 samples were collected every sixth day at all three sites for the period starting from 09/21/2007 to 09/21/2008 (Table 1; Appendix I). Fewer samples were collected from platform B due to a sampler operation failure. Two 2-week intensive samplings were conducted during winter (01/2007 and 03/2007) and summer (07/2008) with samples being collected twice per day (for durations of 7:00 – 19:00 and 19:00 – next day 7:00). During each intensive sampling, twelve samples were collected at each platform except for platform B due to the sampler problem. Eleven sets of size-segregated aerosol samples were collected by a Micro-Orifice Uniform Deposit Impactor (MOUDI) with Teflon filters (47 mm diameter). MOUDI samples were collected during winter (12/11/2007-

2/27/2008) and summer (7/3/2008-7/23/2008) at platform A (Appendix V). The 50% cutoffs of the MOUDI sampler are 0.18, 0.32, 0.56, 1.0, 1.8, 3.2, 5.6, 10 and 18 μm, with the sampling flow rate being maintained at ~ 30.0 l/min. The duration for each sampling set ranged from 72 to 96 hours. Both PM2.5 and MOUDI sample filters were immediately stored in refrigerator after sampling until chemical analysis.

### 3.2 Chemical Analysis

The concentrations of Al, Cd, Cr, Cu, Fe, Ni, Pb, Sc, V, and Zn were determined by High Resolution Inductively Coupled Plasma Mass Spectrometry (HR-ICP-MS) (Finnigan™ ELEMENT2, Thermo Scientific) at the Institute of Marine and Coastal Science, Rutgers University, based on EPA method 3052 through the use of a microwave system (MARs, CEM Corporation). The detection limit of the instrumental method for each tested trace metal is less than 1 ppq and the precision is ~2%. Analytical method validations were made using two different standard reference materials (details in Section 3). Both PM2.5 and MOUDI samples were analyzed in the same way by the above mentioned method.

### 3.3 QA/QC

#### 3.3.1 Precision

Precision is assessed for both duplicate digest aliquots and duplicate sample splits. Relative Percent Difference (RPD) was calculated using the equation shown below.

$$RPD = \frac{S - D}{0.5(S + D)} \times 100$$

where S equals to trace metal concentration in aliquot 1 or split 1; D is the concentration of duplicate aliquot 2 or duplicate split 2. Tables 2 and 3 are RPD values of duplicate digested aliquots and duplicate sample splits calculated from 15 samples. Most of the trace metals, except for Cd, had less than 10% mean RPD of duplicate digest aliquot. Cd showed slightly higher mean RPD value and could be resulted from sample 032508-A with an unusually high RPD, 22.1%. RPD of duplicate splits were higher than duplicate aliquots, but still in the reasonable range for a 10.0% aerosol sampling error. Note RPD of duplicate splits were slightly higher than 10% for Cd, Pb, Al, Sc and Zn and 20% for Cr.

### 3.3.2 Accuracy

Two different recovery experiments were carried out to test the accuracy of the ICP-MS procedure using different standard reference materials: one was an air particulate standard of PM2.5 (SRM2783), and the other was urban particulate matter standard (SRM1648a). The details of the SRMs are described below.

Air particulate on filter media SRM 2783 (National Institute of Standard and Technology, Gaithersburg, MD) contains eight elements measured in this study: Al, Cr, Cu, Fe, Ni, Pb, V, and Zn. As it is an air particulate sample reduced in particle size to simulate PM2.5 air particulate matter, we consider that this SRM could address experimental accuracy well, even without external checks by other analytical methods. Table 4 showed the experiment recovery of those traces metals. All trace metals except for Ni were satisfied with high recoveries. Accordingly, we adjusted the Ni concentrations for samples with the measured recovery for this element.

The second reference material, SRM 1648a (National Institute of Standards and Technology, Gaithersburg, MD), contains nine elements measured in this study: Al, Cd, Cr, Cu, Fe, Ni, Pb, V, and Zn. The recovery of the target elements ranged from 89.9% to 110% (Table 5). Other than Cr and Ni, the results from these two recovery experiments are comparable. The discrepancies in Cr and Ni are thought to arise from the different particle sizes of the two SRMs. The application of these two standard reference materials should serve as a cross-check of the method reliability.

### 3.3.3 Completeness

Following completion of the analytical testing, the percent completeness was calculated using the following equation:

$$Completeness = \frac{V}{P} \times 100$$

where V is the number of valid measurements; P is the number of planned measurements. Most of the trace metals at the three platforms showed higher than 95% completeness, except for platform B, where certain trace metals (e.g. Al and Sc) showed less than 90% completeness (Table 6). The reason was that two samples, 031908-B and 032508-B, were considered as outliers and deleted at the beginning. It is highly possible that they were contaminated by soil as evidenced by the extremely high concentrations of crustal elements, Al and Sc.

## 4. RESULTS

### 4.1 Results from PM2.5 Samples

### 4.1.1 Annual Mean Concentrations and Concentration Gradients of Trace Metals

As the ambient concentrations of traffic related trace metals at a specific location are dependent upon the distance from their sources, the three platforms at distance 50, 100 and 150 m away from the highway were expected to show certain gradients in trace metal concentrations. Annual mean concentrations (Table 7) showed decreasing gradients for Al, Cd, Cu and Pb as a function of distance from the highway. The concentrations of Al and Pb decreased more steeply from platform A to platform B, compared with their decline in concentration from platform B to platform C, while the concentrations of Cd and Cu decreased evenly among the three platforms. Another two trace metals, Cr and Fe, also showed concentration decreasing from platform A to platform C, although at platform C, their concentrations were slightly higher than those at platform B. In general, for above trace metals, concentrations decreased 10-40% from platform A to platform C. However, certain trace metals in this study showed an opposite trend. Between platforms A and C, concentrations of Sc increased from 20-30%. The remaining trace metals (Ni, V, and Zn) also increased in concentration as a function of distance with smaller gradients.

#### 4.1.2 Seasonal Concentration Variations of Trace Metals

Time series of ten trace metals (Figures 1 to 10, Appendix II) showed similar patterns at the three platforms. Normally, higher concentrations at platform A corresponded to higher concentrations at platforms B and C; however, there were several exceptions. For example, on September 3, 2008, Fe concentration at platform A was 826 ng $m^{-3}$, an extremely high value compared with its annual concentrations, whereas, at Platform B and C, Fe concentrations were only 57.2 ng $m^{-3}$ and 13.4 ng $m^{-3}$, even lower than the annual average (Figure 5). As there were no significant changes in traffic volume and weather conditions, it was hard to explain whether those exceptions were contamination or aerosol properties. In Figures 1 to 10, except for Ni, other trace metals showed higher concentrations in spring and summer at platforms A and B: Cr, Cu, Fe and V were higher in summer. However, at platform C, Cr, Cu, Fe and V showed relatively higher concentrations in fall. The highest concentrations of Ni at three platforms all occurred in the fall.

Seasonal samples also provided more detailed concentration gradient changes (Table 8). In this report, the definition of four seasons is: spring in March, April and May; summer in June, July and August; fall refers to the period from September to November; and winter refers to the period from December through February. All trace metals measured showed a concentration increase from platform A to platform C in the fall, regardless of an increase or decrease in the annual average concentration gradients. In winter, spring and summer, most trace metal concentrations showed negative correlation with distance. For example, in spring, Cu concentration declined from 63.1 ng $m^{-3}$ at platform A to 15.3 ng $m^{-3}$ at platform C.

#### 4.1.3 Weekday-Weekend Concentration Variations of Trace Metals

Most trace metal concentrations showed higher concentrations on weekdays than on weekends at three platforms (Table 9). Due to the higher traffic density, during weekdays, Fe concentrations were almost twice as high and most other trace metal concentrations 19.7-42.4% higher than during the weekends. However, Cd and Cu appeared to have no significant concentration difference between weekdays and weekends.

#### 4.1.4 Diurnal Concentration Variations of Trace Metals Observed during the Intensives

Two sets of intensive sampling, one in winter and one in summer, showed diurnal variations in trace metal concentrations (Table 10, Appendix III). In general, at platforms A and B, trace metal concentrations during day were higher than those at night. Their concentrations are similar to the behavior of total suspended particulates and airborne hydrocarbons, increasing during daytime. There were two exceptions: Cu showed higher concentrations at night in both winter and summer, and V only presented the same pattern in summer. On the other hand, at platform C, there were higher concentrations at night for seven trace metals (Al, Cd, Cr, Fe, Ni, Pb and Zn) in winter and two (Cr and Cu) in summer. As total particulate number and elemental carbon could also have peaks in both day and night times (Kim et al., 2002), depending on several factors such as local vehicular emissions and different meteorological conditions, diurnal variations of trace metal concentrations need more investigation.

There were also spatial concentration variations in two sets of intensive samples between day and night (Table 10). In winter, seven trace metals (Cr, Fe, Mn, Ni, Pb, Sb and Zn) showed increasing concentration gradients at night, whereas during the day, decreasing concentration gradients were more often. In summer, all trace metals appeared negative correlation between concentrations and distance change in both day and night.

### 4.2 Results from MOUDI Samples

During two intensive samplings, six sets of samples in winter and five sets in summer were collected using MOUDI to study the size distributions of the selected trace metals associated with ambient particulate matter. The results are listed in Appendix V.

#### 4.2.1 Size Distributions of Al

Primarily, Al was primarily accumulated in the coarse mode, with unique peak at the size range of 3.2-5.6 μm and very low concentrations in fine particles in both winter and summer (Figure 11). Al showed higher concentrations at each size range in summer compared with winter, while the event-based variations of Al concentrations in coarse particles were smaller in summer than those in winter. In addition, the event-based concentration variations in fine particles were not as significant as those in coarse particles.

#### 4.2.2 Size Distributions of Fe

Primarily, Fe showed an asymmetrical normal size distribution with unique peak at the size range of 3.2-5.6 μm in both winter and summer (Figure 15). Its concentrations in fine particles were low, and did not show significant differences in the two seasons; while in coarse particles, its concentrations were relatively higher in winter. The event-based variations of both concentrations and size distributions occurred mainly in coarse particles, and they were greater in winter compared with summer. The characteristics of Fe size distributions indicate that the main sources of aerosol Fe in the studied area were crustal in nature.

#### 4.2.3 Size Distributions of Sc

Sc accumulated more in coarse particles in both winter and summer with the peak ranging from 1.8 to 3.2 μm (Figure 18). Its concentrations showed obvious seasonal variations with much higher concentrations in summer compared with winter. The size distributions of Sc in winter were more complex with higher event-based variations, while in summer, the size distributions for each single event showed similar patterns, even though its concentration variations were obvious.

#### 4.2.4 Size Distributions of Cd

The size distributions of Cd showed typical bimodal pattern in winter, while in summer, its size distributions were mainly of decreasing patterns as a function of particle size from fine to coarse (Figure 12). In addition, the concentrations of Cd were much higher in almost the all sizes in winter compared with summer. Basically, the event-based variations of size distributions and concentrations of Cd were small, especially in winter, except for the $6^{th}$ set of samples in winter.

#### 4.2.5 Size Distributions of Cr

The size distributions of Cr in both winter and summer also exhibited a typical bimodal pattern. However, different from Cd, the two peaks were both observed in coarse particles for most sample sets, with the highest peak at the size range of 3.2-5.6 μm and a minor peak at 1.0-1.8 μm (Figure 13). Compared with summer, in winter the 1.0-1.8 μm peaks were relatively higher while the 3.2-5.6 μm peaks were slightly lower. Cr concentrations in particles with size range of 0.56-3.2 μm were higher in winter while the Cr concentrations in particles with size greater than 3.2 μm were higher in summer. The event-based variations of both size distributions and concentrations of Cr were greater in winter than summer (Figure 13). In summer, the event-based variations of Cr concentrations were greater in coarse particles than fine particles.

**4.2.6 Size Distributions of Cu**

The size distributions of Cu were similar to that of Cr, showing bimodal patterns with two peaks at the size ranges of 1.0-1.8 μm and 3.5-5.6 μm (Figure 14). However, different to the size distributions of Cr, the highest peak of Cu size distribution was at the size range of 1.0-1.8 μm. Both the concentrations and size distributions of Cu were similar in winter and summer. Besides, the event-based size distribution variations were not significant, while the event-based concentration variations were high in both seasons.

**4.2.7 Size Distributions of Ni**

A decreasing pattern was found for the size distributions of Ni in atmospheric particles, with relatively higher accumulations in fine particles and lower accumulations in coarse particles in both winter and summer seasons (Figure 16). The event-based variations of Ni concentrations in the study area were not obvious when compared with other trace metals. Comparatively, the concentrations of Ni in the atmospheric particles were lower in summer than in winter.

**4.2.8 Size Distributions of Pb**

As shown in Figure 17, the size distributions of particulate Pb observed in this study were complex and different size distribution patterns were found in different seasons. In winter, it was more accumulated in fine particles with relatively higher concentrations in particles with a size range of 0.18-1.8μm, while for the coarser particles the Pb concentrations were much lower. In summer, similar accumulation levels were observed for both the particles with size greater than

1.8μm and particles with size smaller than 1.8μm. For the particles with sizes greater than 1.8μm, there were no significant seasonal variations in Pb concentrations. In winter, the event-based variations of Pb concentrations were greater, especially for the particles with sizes greater than 1.8μm.

### 4.2.9 Size Distributions of V

The size distribution of V in atmospheric particles was similar to that of Ni observed in this study, showing a declining pattern with highest concentrations in finest particles (Fig. 9). However, different to Ni, the V concentrations were mainly of similar levels, especially for the particles with size greater than 0.56μm. In addition, the event-based variations of V concentrations in the atmospheric particles were small in both winter and summer seasons.

### 4.2.10 Size Distributions of Zn

A fluctuating pattern was found for the size distributions of Zn in atmospheric particles, as shown in Fig. 10. In winter, Zn was more of fine particle accumulations, while in summer its concentrations were all of similar levels for both fine and coarse particles. Seasonal variations of the concentrations were also found with lower concentrations in summer. As for the event-based variations of Zn concentrations, it was greater in winter and much smaller in summer.

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**Figure Captions:**

Figure 1. Time series of Al concentrations (09/2007-09/2008)

Figure 2. Time series of Cd concentrations (09/2007-09/2008)

Figure 3. Time series of Cr concentrations (09/2007-09/2008)

Figure 4. Time series of Cu concentrations (09/2007-09/2008)

Figure 5. Time series of Fe concentrations (09/2007-09/2008)

Figure 6. Time series of Ni concentrations (09/2007-09/2008)

Figure 7. Time series of Pb concentrations (09/2007-09/2008)

Figure 8. Time series of Sc concentrations (09/2007-09/2008)

Figure 9. Time series of V concentrations (09/2007-09/2008)

Figure 10. Time series of Zn concentrations (09/2007-09/2008)

Figure 11. Mass size distributions of Al in winter and summer

Figure 12. Mass size distributions of Cd in winter and summer

Figure 13. Mass size distributions of Cr in winter and summer

Figure 14. Mass size distributions of Cu in winter and summer

Figure 15. Mass size distributions of Fe in winter and summer

Figure 16. Mass size distributions of Ni in winter and summer

Figure 17. Mass size distributions of Pb in winter and summer

Figure 18. Mass size distributions of Sc in winter and summer

Figure 19. Mass size distributions of V in winter and summer

Figure 20. Mass size distributions of Zn in winter and summer

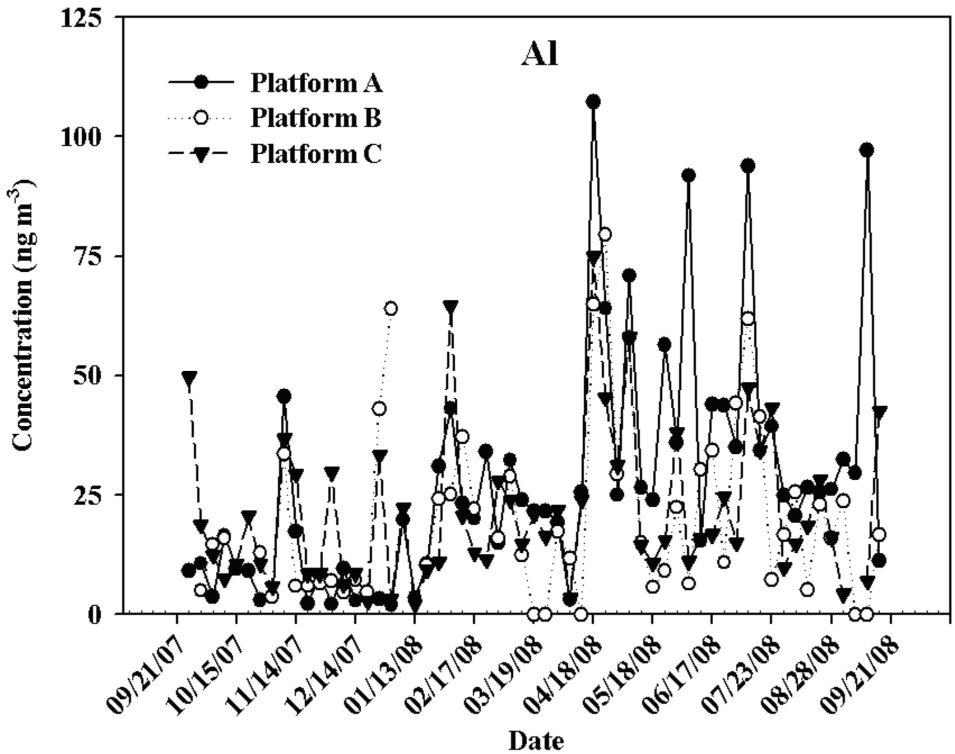

Al
Platform A
Platform B
Platform C
Concentration (ng m-3)
125
100
75
50
25
0
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date

Figure 1

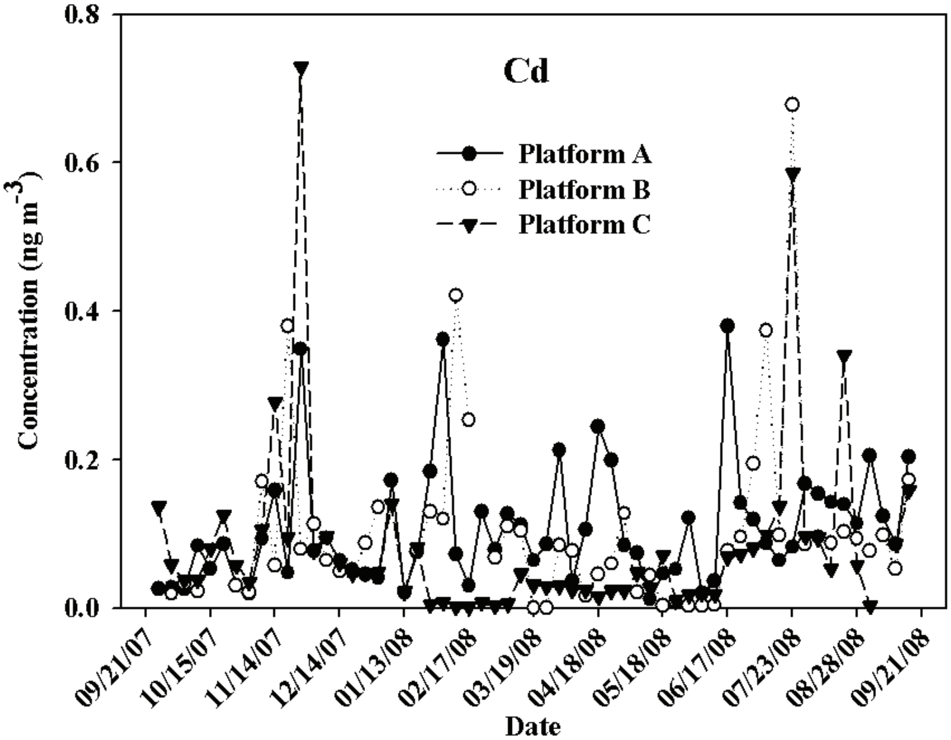

Cd
Platform A
Platform B
Platform C
Concentration (ng m$^{-3}$)
0.8
0.6
0.4
0.2
0.0
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date

Figure 2

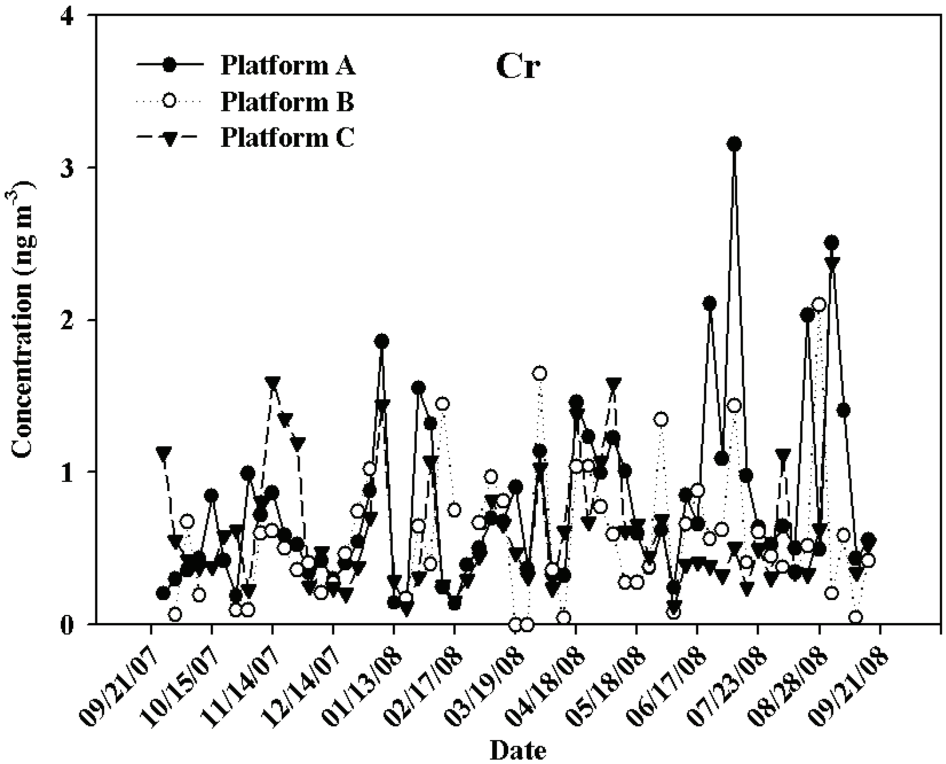
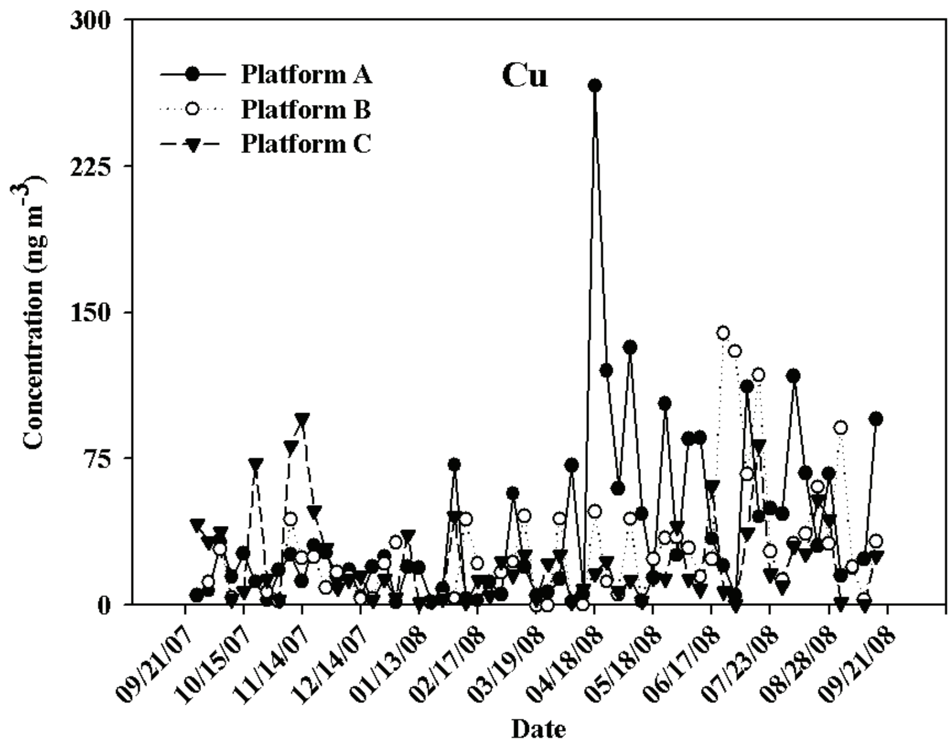

Cr
Platform A
Platform B
Platform C
Concentration (ng m$^{-3}$)
0
1
2
3
4
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date

Figure 3



Cu
Platform A
Platform B
Platform C
Concentration (ng m-3)
300
225
150
75
0
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date


Figure 4

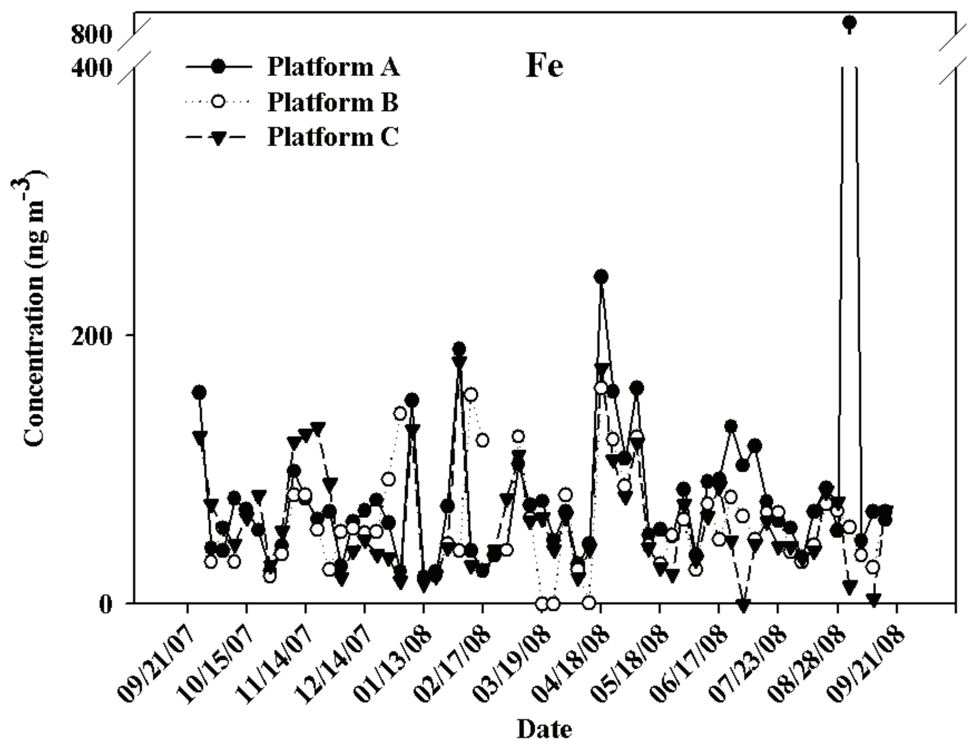
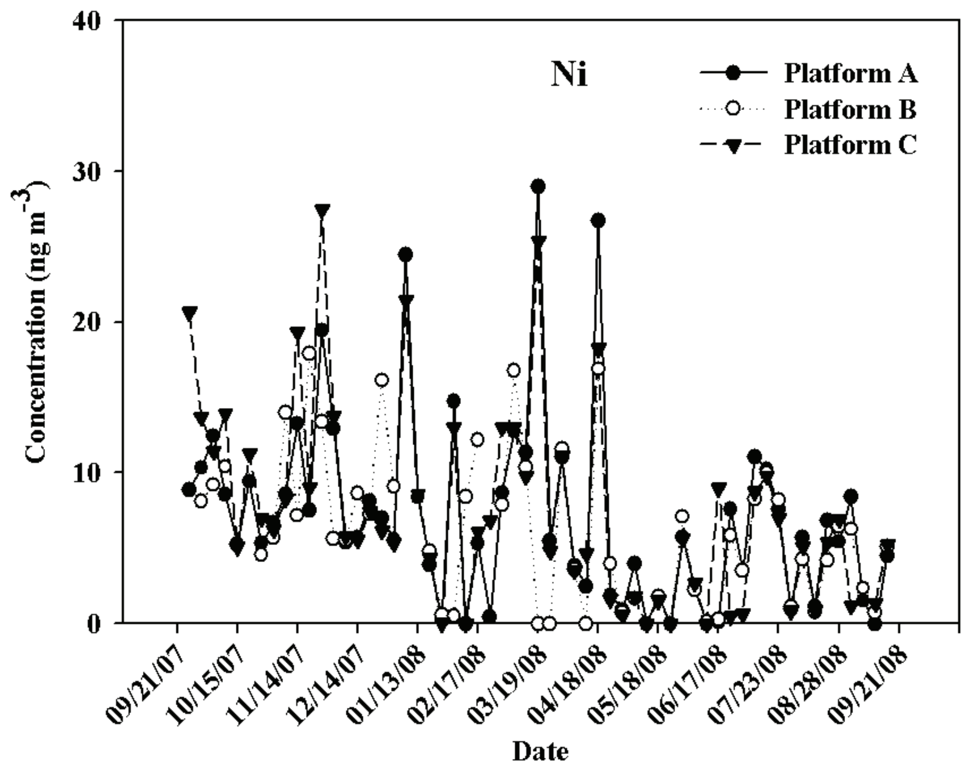
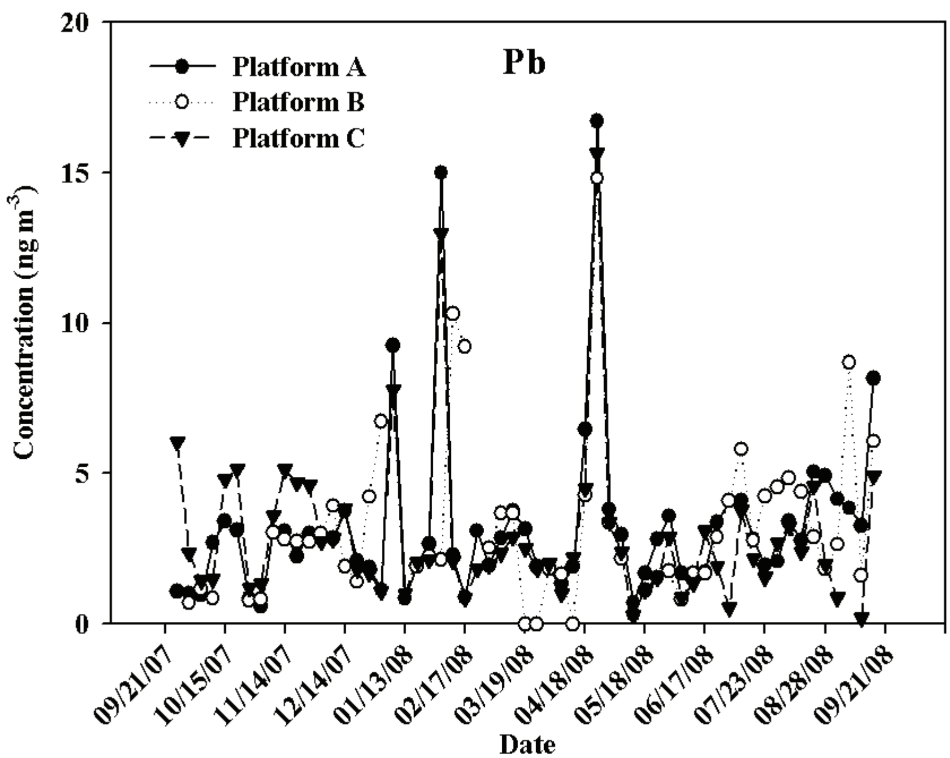

800
400
Platform A
Platform B
Platform C
Fe
Concentration (ng m-3)
200
0
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date

Figure 5



Ni
Platform A
Platform B
Platform C
Concentration (ng m$^{-3}$)
0
10
20
30
40
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date


Figure 6



Pb
Platform A
Platform B
Platform C
Concentration (ng m-3)
20
15
10
5
0
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date


Figure 7

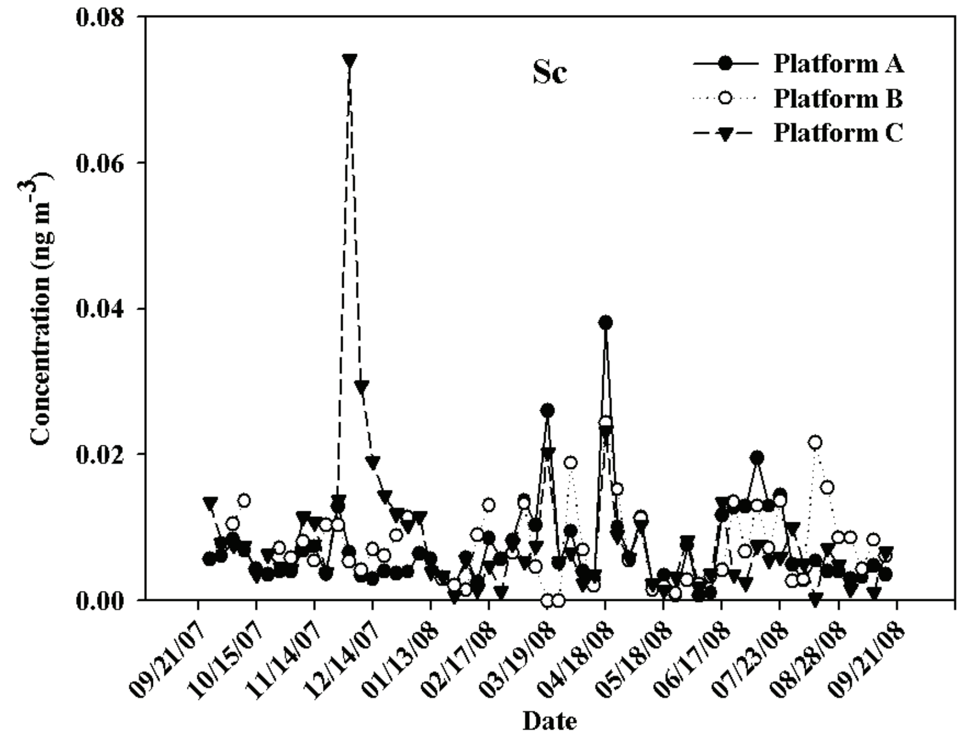
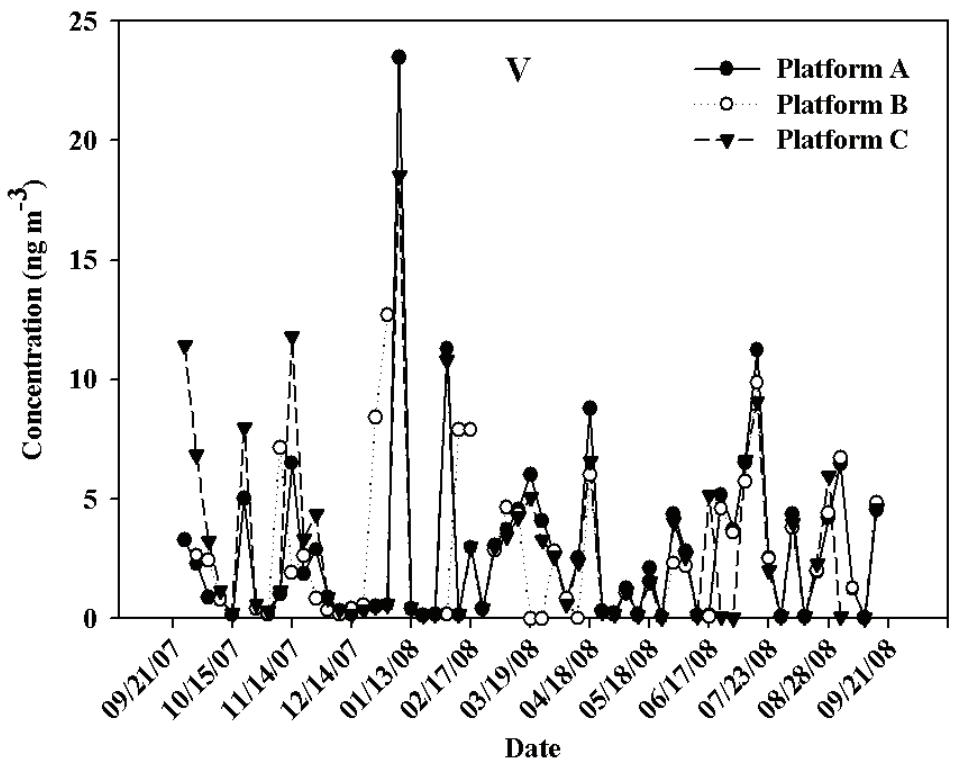

0.08
0.06
0.04
0.02
0.00
Concentration (ng m-3)
Sc
Platform A
Platform B
Platform C
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date

Figure 8


V
Platform A
Platform B
Platform C
Concentration (ng m$^{-3}$)
Date
0
5
10
15
20
25
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
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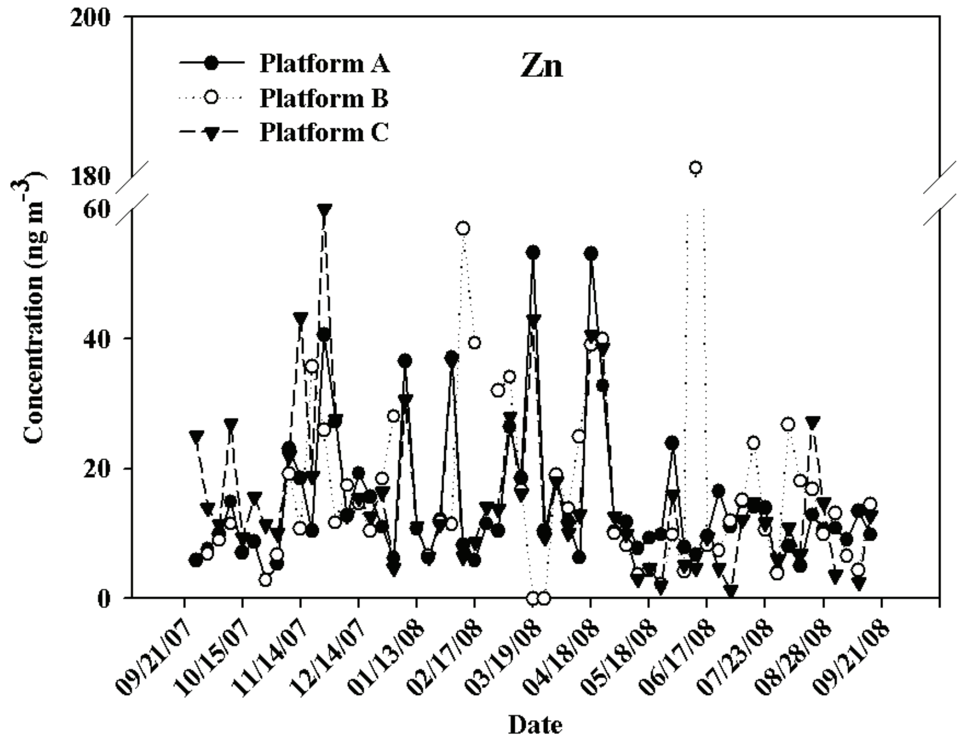
08/28/08
09/21/08

Figure 9



200
180
60
40
20
0
Concentration (ng m-3)
Platform A
Platform B
Platform C
Zn
09/21/07
10/15/07
11/14/07
12/14/07
01/13/08
02/17/08
03/19/08
04/18/08
05/18/08
06/17/08
07/23/08
08/28/08
09/21/08
Date


Figure 10

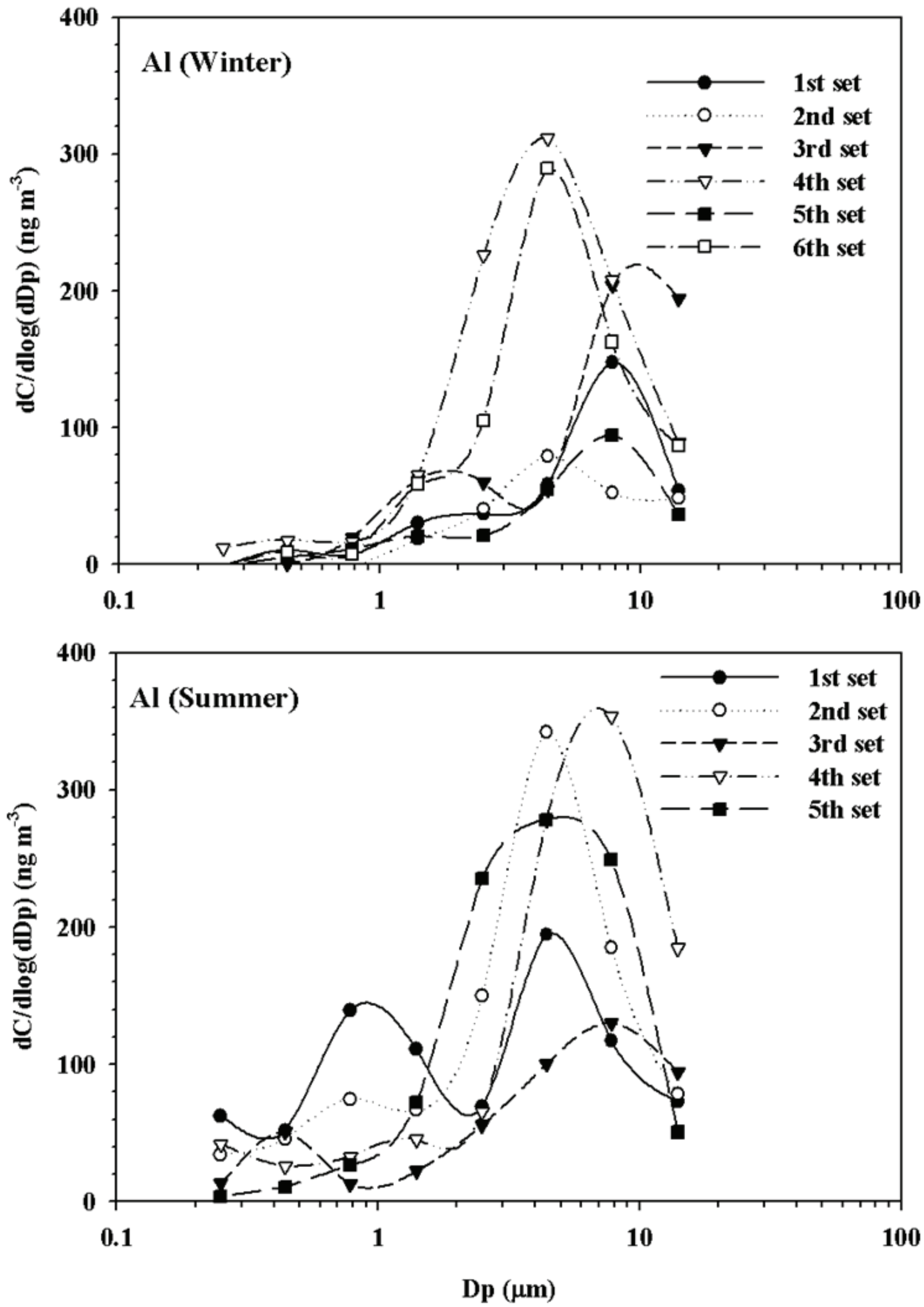

Al (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m^-3)
400
300
200
100
0
0.1
1
10
100
Al (Summer)
1st set
2nd set
3rd set
4th set
5th set
Dp (μm)

Figure 11

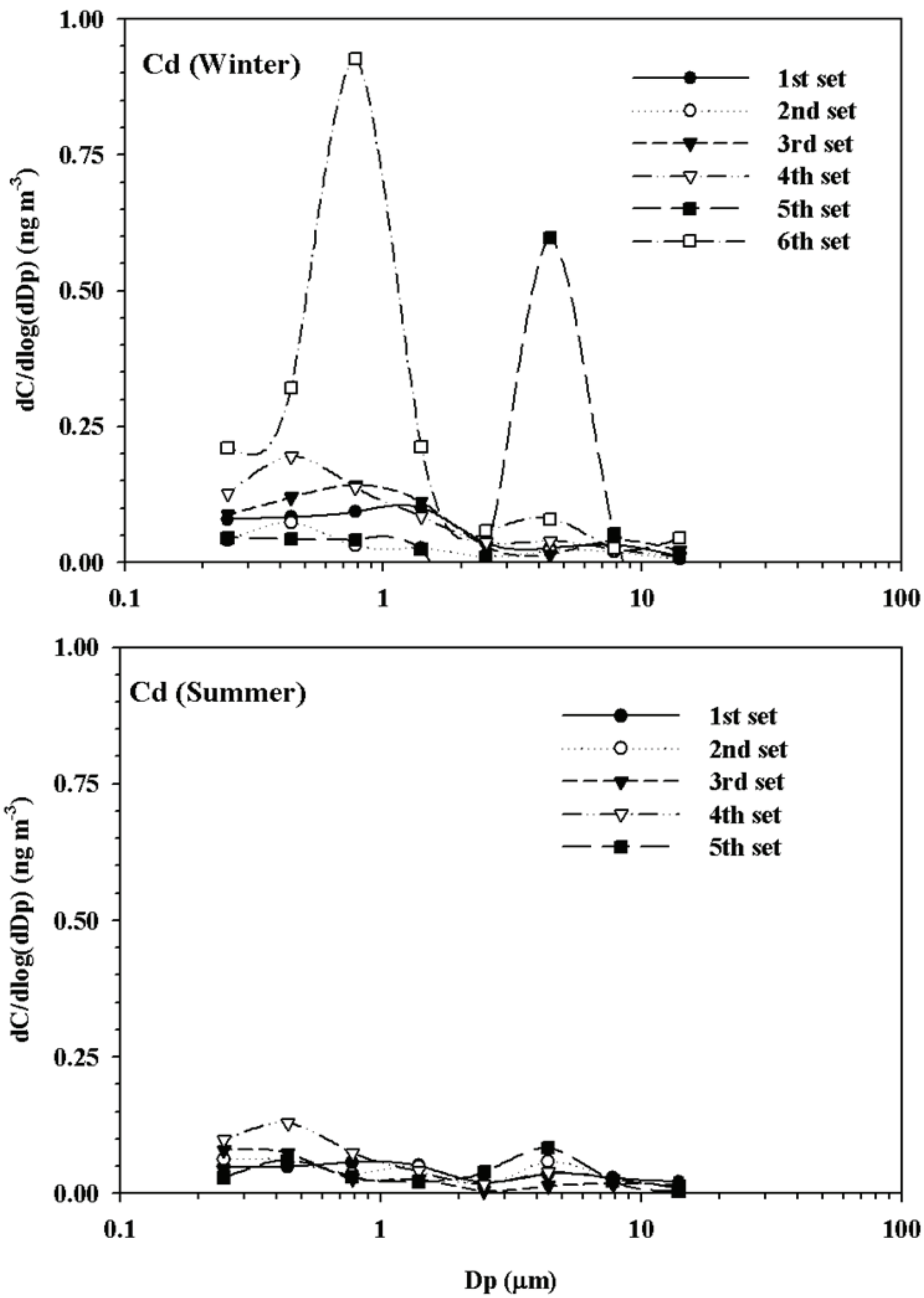

Cd (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m-3)
1.00
0.75
0.50
0.25
0.00
0.1
1
10
100
Cd (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
1.00
0.75
0.50
0.25
0.00
0.1
1
10
100
Dp (μm)

Figure 12

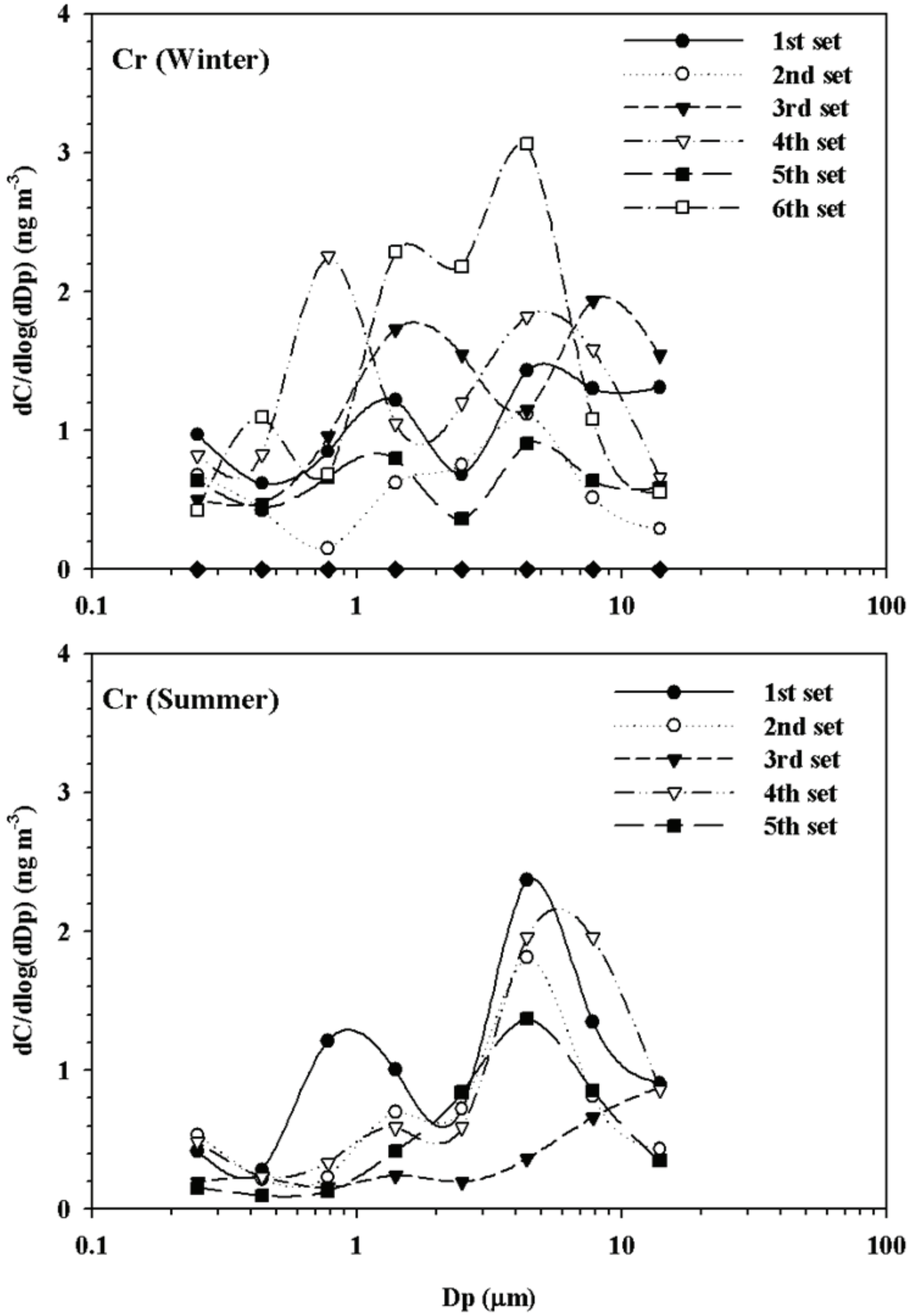

Cr (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m-3)
0
1
2
3
4
0.1
1
10
100
Cr (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
0
1
2
3
4
0.1
1
10
100
Dp (μm)

Figure 13

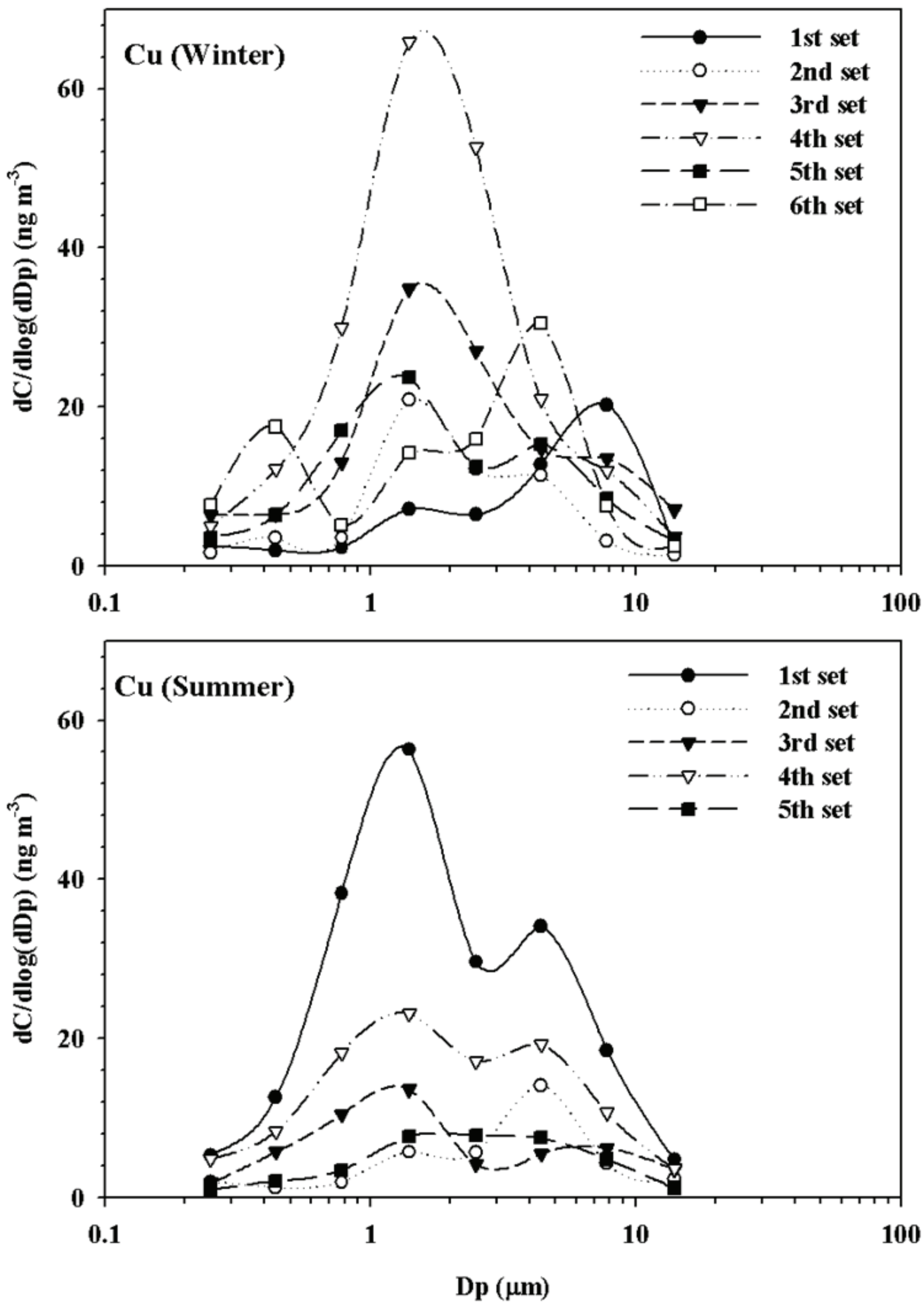

Cu (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m-3)
0
20
40
60
0.1
1
10
100
Cu (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
0
20
40
60
0.1
1
10
100
Dp (μm)

Figure 14

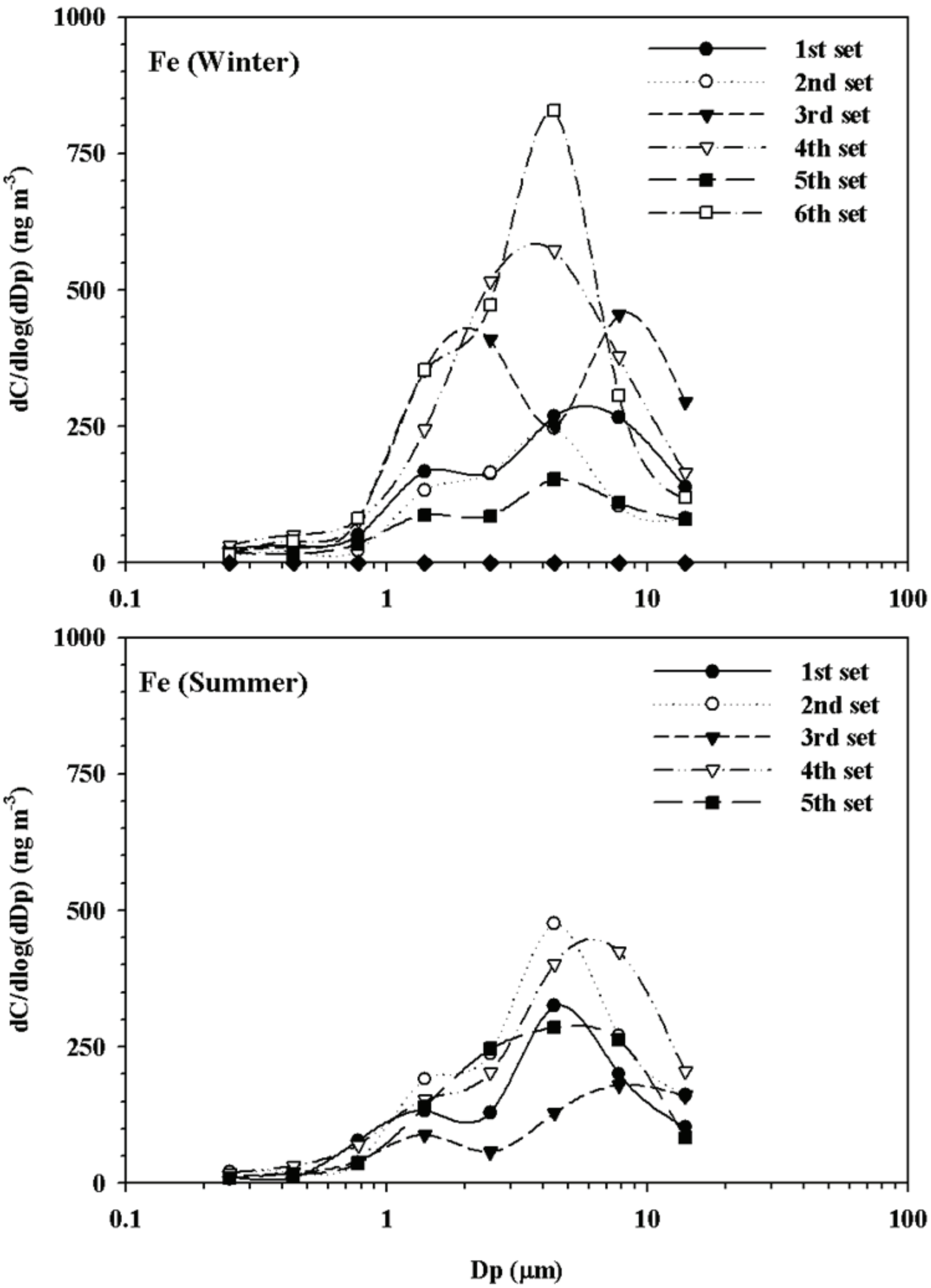
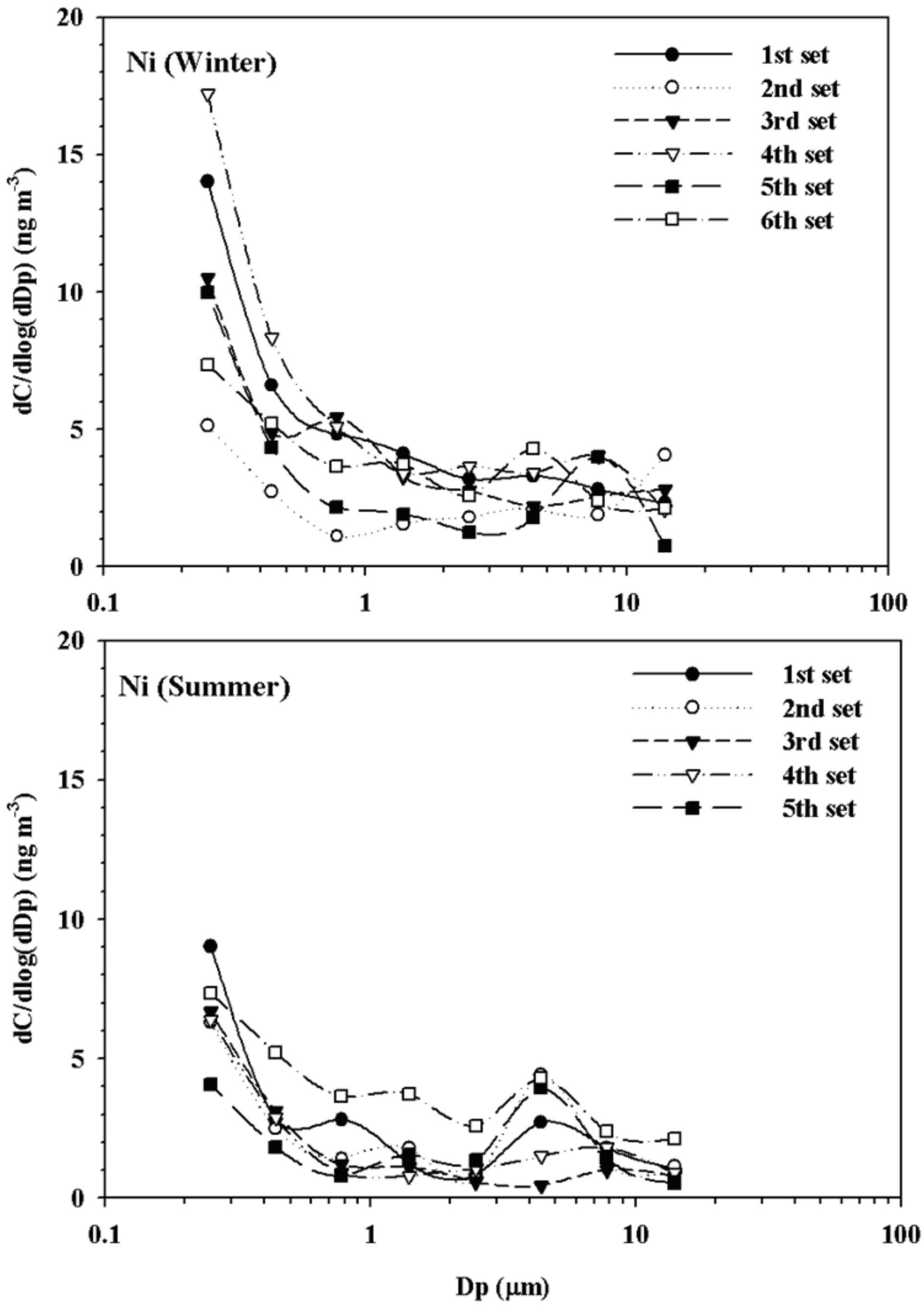

Fe (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m-3)
1000
750
500
250
0
0.1
1
10
100
Fe (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
1000
750
500
250
0
0.1
1
10
100
Dp (µm)

Figure 15



Ni (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m$^{-3}$)
0
5
10
15
20
0.1
1
10
100
Ni (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m$^{-3}$)
0
5
10
15
20
0.1
1
10
100
Dp (μm)


Figure 16

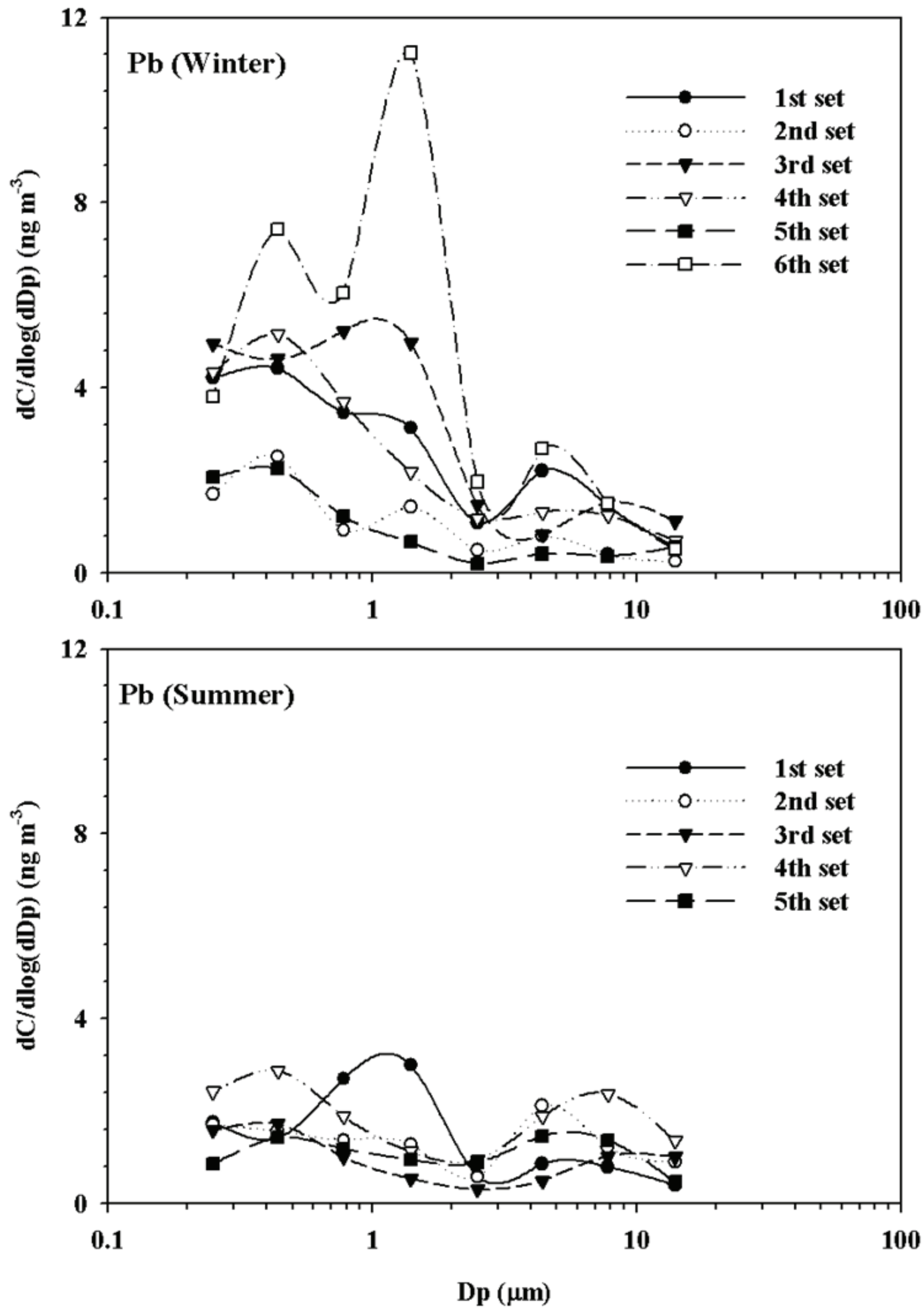
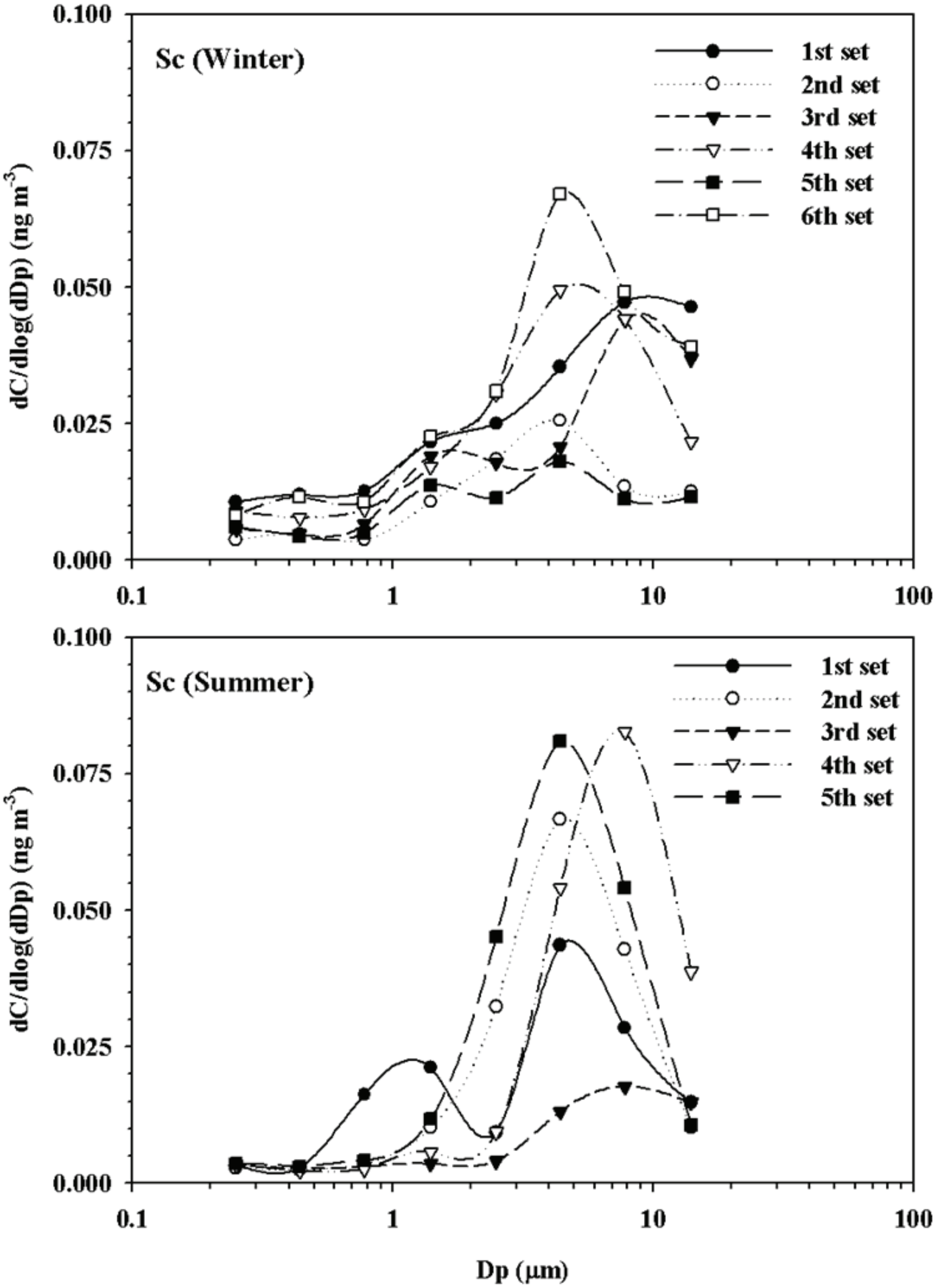

Pb (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m-3)
12
8
4
0
0.1
1
10
100
Pb (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
12
8
4
0
0.1
1
10
100
Dp (μm)

Figure 17



Sc (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
Sc (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
0.000
0.025
0.050
0.075
0.100
0.1
1
10
100
Dp (µm)


Figure 18

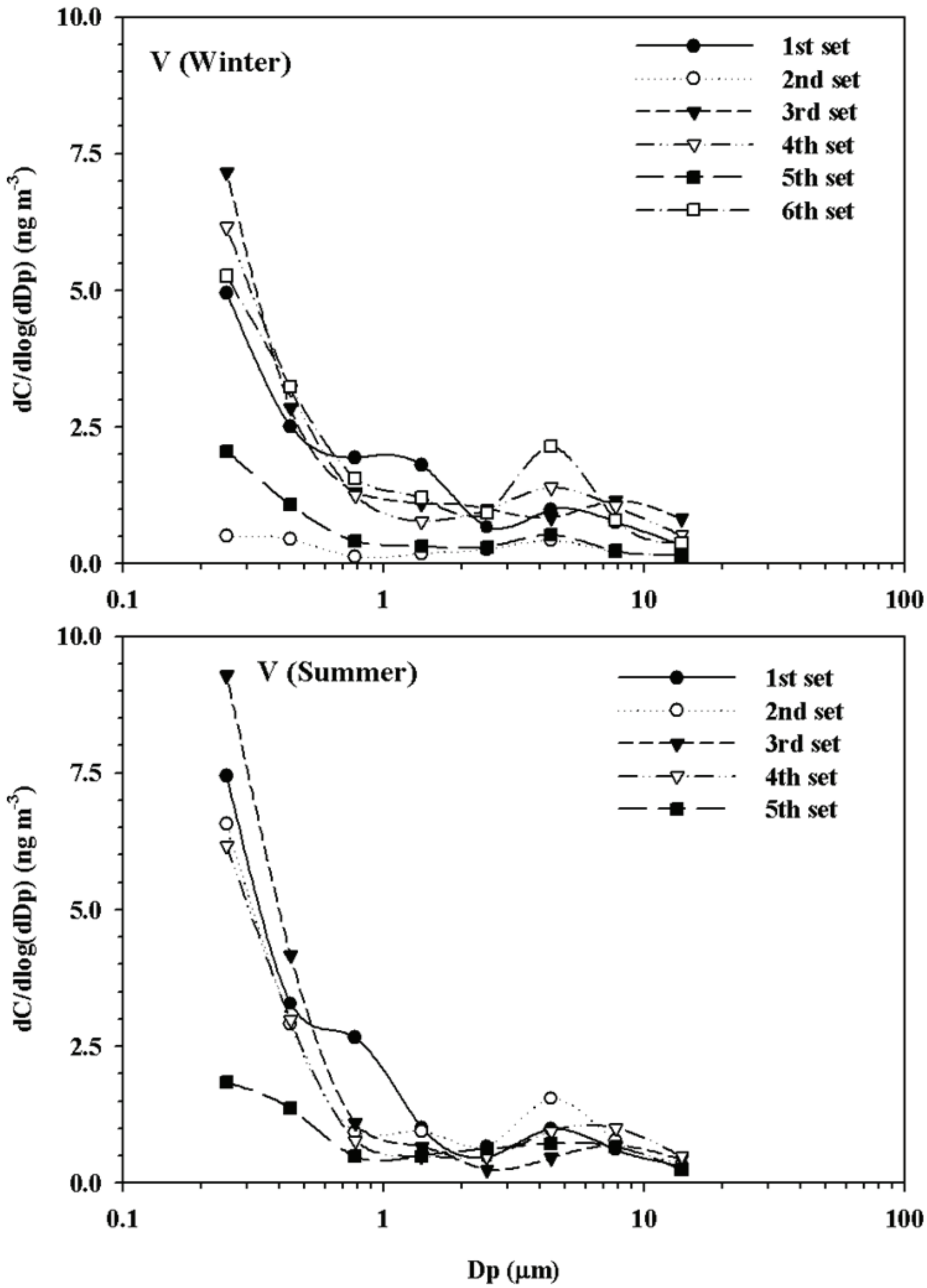

V (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m$^{-3}$)
10.0
7.5
5.0
2.5
0.0
0.1
1
10
100
V (Summer)
1st set
2nd set
3rd set
4th set
5th set
Dp (μm)

Figure 19

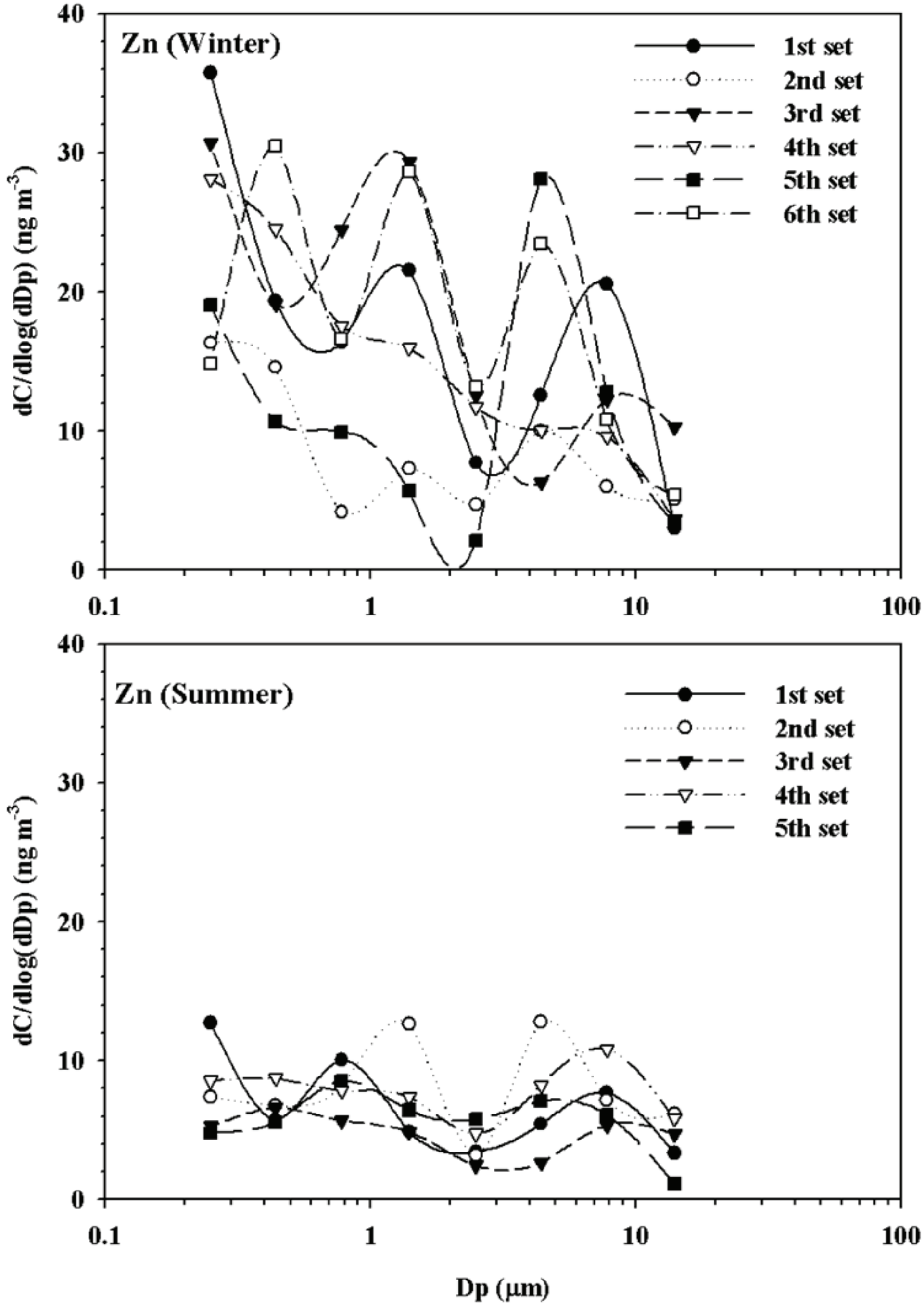

Zn (Winter)
1st set
2nd set
3rd set
4th set
5th set
6th set
dC/dlog(dDp) (ng m-3)
0
10
20
30
40
0.1
1
10
100
Zn (Summer)
1st set
2nd set
3rd set
4th set
5th set
dC/dlog(dDp) (ng m-3)
0
10
20
30
40
0.1
1
10
100
Dp (μm)

Figure 20

Table 1. Sampling information.

| Sampling Type | Sampling Period | Number of Samples | | |
|---|---|---|---|---|
| | | Platform A | Platform B | Platform C |
| One -Year Time Series | 09/21/07-09/21/08 | 59 | 47 | 58 |
| Winter Intensive | 01/29/08-01/31/08 | 6 | 2 | 6 |
| | 03/07/08-03/09/08 | 6 | 6 | 6 |
| Summer Intensive | 07/17/08-07/29/08 | 10 | 10 | 10 |
| | 09/04/08 | 2 | 2 | 2 |

Table 2. Air concentrations (ng m$^{-3}$) of trace metals in duplicate digest aliquots and their RPD (%).

| Sample ID | Duplicate Aliquots | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 122607-A | A-1[a] | 3.17 | 0.0452 | 0.543 | 24.9 | 60.4 | 7.00 | 1.88 | 0.00370 | 0.503 | 11.0 |
| | A-2[a] | 3.27 | 0.0454 | 0.503 | 23.8 | 57.9 | 6.65 | 1.92 | 0.00374 | 0.483 | 11.2 |
| | RPD | 3.16 | 0.411 | 7.67 | 4.66 | 4.33 | 5.10 | 1.90 | 1.28 | 4.15 | 1.65 |
| 010108-A | A-1 | 2.06 | 0.0403 | 0.877 | 1.48 | 24.2 | 5.57 | 1.14 | 0.00394 | 0.575 | 6.17 |
| | A-2 | 2.06 | 0.0385 | 0.904 | 1.46 | 25.1 | 5.64 | 1.14 | 0.00357 | 0.584 | 6.02 |
| | RPD | 0.119 | 4.45 | 3.01 | 0.806 | 3.86 | 1.33 | 0.383 | 9.90 | 1.58 | 2.34 |
| 010708-A | A-1 | 19.8 | 0.172 | 1.86 | 19.6 | 151 | 24.5 | 9.25 | 0.00648 | 23.5 | 36.6 |
| | A-2 | 20.8 | 0.180 | 2.02 | 19.9 | 162 | 24.4 | 9.49 | 0.00690 | 25.1 | 36.5 |
| | RPD | 4.90 | 4.74 | 8.16 | 1.52 | 6.93 | 0.426 | 2.65 | 6.29 | 6.63 | 0.243 |
| 020508-A | A-1 | 43.1 | 0.362 | 1.32 | 71.9 | 189 | 14.7 | 15.0 | 0.00589 | 11.3 | 37.1 |
| | A-2 | 43.3 | 0.348 | 1.210 | 74.3 | 175 | 15.0 | 13.5 | 0.00596 | 10.3 | 39.6 |
| | RPD | 0.491 | 3.88 | 8.64 | 3.29 | 7.72 | 2.03 | 10.8 | 1.15 | 8.81 | 6.59 |
| 032508-A | A-1 | 21.6 | 0.0864 | 0.366 | 6.57 | 47.5 | 5.49 | 1.89 | 0.00514 | 4.10 | 10.4 |
| | A-2 | 21.2 | 0.0967 | 0.317 | 6.30 | 49.5 | 5.21 | 1.75 | 0.00516 | 3.85 | 10.9 |
| | RPD | 2.19 | 11.2 | 14.6 | 4.18 | 4.14 | 5.33 | 7.76 | 0.448 | 6.28 | 4.72 |
| 042408-A | A-1 | 64.0 | 0.199 | 1.23 | 120 | 158 | 1.89 | 16.7 | 0.0101 | 0.321 | 32.8 |
| | A-2 | 72.7 | 0.188 | 1.23 | 132 | 161 | 2.04 | 17.7 | 0.0104 | 0.333 | 32.6 |
| | RPD | 12.7 | 5.39 | 0.677 | 9.34 | 1.75 | 7.79 | 5.52 | 2.77 | 3.42 | 0.640 |
| 022308-A | A-1 | 34.0 | 0.129 | 0.393 | 11.6 | 36.2 | 0.446 | 3.09 | 0.00567 | 0.419 | 11.5 |
| | A-2 | 34.1 | 0.127 | 0.419 | 11.8 | 37.3 | 0.440 | 3.15 | 0.00542 | 0.405 | 11.2 |
| | RPD | 0.475 | 1.62 | 6.26 | 1.94 | 2.85 | 1.40 | 1.77 | 4.49 | 3.39 | 2.37 |
| 012508-A | A-1 | 31.1 | 0.184 | 1.55 | 8.10 | 72.7 | 0.326 | 2.66 | 0.00202 | 0.199 | 12.1 |
| | A-2 | 30.4 | 0.184 | 1.54 | 7.90 | 75.9 | 0.354 | 2.57 | 0.00207 | 0.187 | 14.1 |
| | RPD | 2.28 | 0.064 | 1.07 | 2.52 | 4.30 | 8.15 | 3.46 | 2.50 | 5.94 | 15.1 |
| 031308-A | A-1 | 24.0 | 0.112 | 0.677 | 19.7 | 73.5 | 11.3 | 3.74 | 0.0104 | 4.55 | 18.5 |
| | A-2 | 27.6 | 0.110 | 0.631 | 18.1 | 68.2 | 11.6 | 3.66 | 0.0102 | 4.27 | 19.3 |
| | RPD | 14.1 | 2.00 | 6.98 | 8.33 | 7.41 | 1.99 | 2.14 | 1.79 | 6.14 | 4.47 |

(to be continued)

(continued)

| Sample ID | Duplicate Aliquots | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 082208-B | A-1 | 23.0 | 0.103 | 0.518 | 60.5 | 74.1 | 4.21 | 2.88 | 0.0155 | 2.02 | 16.9 |
| | A-2 | 23.3 | 0.102 | 0.534 | 62.4 | 71.8 | 4.29 | 3.06 | 0.0159 | 2.08 | 15.7 |
| | RPD | 1.05 | 1.55 | 2.97 | 2.96 | 3.24 | 1.83 | 5.95 | 2.43 | 2.67 | 7.34 |
| 082808-B | A-1 | 15.9 | 0.0940 | 2.10 | 31.0 | 69.0 | 6.45 | 1.84 | 0.00859 | 4.42 | 9.87 |
| | A-2 | 15.6 | 0.0983 | 2.04 | 32.0 | 64.3 | 6.91 | 1.83 | 0.00888 | 4.37 | 9.26 |
| | RPD | 1.77 | 4.43 | 2.99 | 1.80 | 7.11 | 6.85 | 0.889 | 3.25 | 1.14 | 6.45 |
| 090308-B | A-1 | 23.7 | 0.0772 | 0.205 | 90.6 | 57.3 | 6.27 | 2.64 | 0.00858 | 6.71 | 13.1 |
| | A-2 | 22.5 | 0.0857 | 0.197 | 88.8 | 59.0 | 6.14 | 2.61 | 0.00938 | 6.51 | 13.9 |
| | RPD | 5.17 | 10.5 | 4.07 | 2.03 | 2.95 | 1.98 | 1.05 | 8.84 | 2.98 | 5.72 |
| 090908-B | A-1 | -[b] | 0.0985 | 0.584 | 19.7 | 36.2 | 2.35 | 8.70 | 0.00434 | 1.28 | 6.46 |
| | A-2 | - | 0.102 | 0.625 | 20.6 | 38.6 | 2.25 | 8.20 | 0.00447 | 1.28 | 6.74 |
| | RPD | - | 3.931 | 6.89 | 4.37 | 6.31 | 4.58 | 5.95 | 2.92 | 0.108 | 4.35 |
| 091508-B | A-1 | - | 0.0525 | 0.0473 | 2.74 | 26.9 | 0.713 | 1.62 | 0.00830 | 0.0593 | 4.37 |
| | A-2 | - | 0.0499 | 0.0478 | 2.45 | 24.3 | 0.621 | 1.64 | 0.00751 | 0.0608 | 4.49 |
| | RPD | - | 5.12 | 1.20 | 10.9 | 10.5 | 13.9 | 1.09 | 9.98 | 2.51 | 2.52 |
| 092108-B | A-1 | 16.7 | 0.173 | 0.421 | 32.4 | 68.6 | 5.11 | 6.07 | 0.00609 | 4.85 | 14.4 |
| | A-2 | 16.0 | 0.157 | 0.439 | 32.5 | 63.1 | 5.42 | 5.83 | 0.00570 | 4.75 | 12.4 |
| | RPD | 4.06 | 9.65 | 4.17 | 0.378 | 8.43 | 5.84 | 3.99 | 6.51 | 2.20 | 15.1 |
| 080408-C | A-1 | 9.87 | 0.0968 | 0.309 | 9.66 | 42.9 | 0.830 | 2.71 | 0.0100 | 0.0706 | 6.05 |
| | A-2 | 10.2 | 0.0940 | 0.330 | 8.93 | 43.8 | 0.875 | 2.61 | 0.0112 | 0.0715 | 6.27 |
| | RPD | 2.85 | 2.88 | 6.36 | 7.90 | 2.11 | 5.25 | 3.83 | 11.2 | 1.31 | 3.68 |
| | Mean RPD | 3.96 | 4.49 | 5.36 | 4.18 | 5.25 | 4.61 | 3.69 | 4.73 | 3.70 | 5.20 |

[a] A-1: Air concentrations of trace metals in digest aliquot-1; A-2: Air concentrations of trace metals in digest aliquot-2.
[b] Air concentrations less than filter blank

Table 3. Air concentrations (ng $m^{-3}$) of trace metals in sample splits and their RPD (%).

| Sample ID | Duplicate Splits | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 122607-A | S-1[a] | 3.17 | 0.0452 | 0.543 | 24.9 | 60.4 | 7.00 | 1.88 | 0.00370 | 0.503 | 11.0 |
| | S-2[a] | 3.90 | 0.0402 | 0.459 | 21.3 | 54.4 | 5.84 | 1.60 | 0.00313 | 0.456 | 9.45 |
| | RPD | 20.5 | 11.8 | 16.8 | 15.6 | 10.6 | 18.0 | 16.0 | 16.7 | 9.83 | 15.3 |
| 010108-A | S-1 | 2.06 | 0.0403 | 0.877 | 1.48 | 24.2 | 5.57 | 1.14 | 0.00394 | 0.575 | 6.17 |
| | S-2 | 2.15 | 0.0375 | 1.08 | 1.34 | 21.4 | 5.17 | 1.03 | 0.00322 | 0.539 | 4.85 |
| | RPD | 4.11 | 7.16 | 21.0 | 9.64 | 12.2 | 7.38 | 10.2 | 19.9 | 6.41 | 23.9 |
| 010708-A | S-1 | 19.8 | 0.172 | 1.86 | 19.6 | 152 | 24.5 | 9.25 | 0.00648 | 23.5 | 36.6 |
| | S-2 | 19.5 | 0.159 | 1.46 | 18.0 | 139 | 22.4 | 8.49 | 0.00627 | 22.8 | 33.6 |
| | RPD | 1.67 | 7.77 | 23.8 | 8.39 | 8.58 | 8.84 | 8.49 | 3.32 | 2.83 | 8.49 |
| 020508-A | S-1 | 43.1 | 0.362 | 1.32 | 71.9 | 189 | 14.7 | 15.0 | 0.00589 | 11.3 | 37.1 |
| | S-2 | 36.3 | 0.358 | 1.07 | 61.4 | 175 | 12.6 | 12.4 | 0.00490 | 9.90 | 31.9 |
| | RPD | 17.2 | 1.11 | 20.6 | 15.8 | 7.83 | 15.8 | 19.1 | 18.3 | 12.9 | 15.1 |
| 032508-A | S-1 | 21.6 | 0.0864 | 0.366 | 6.57 | 47.5 | 5.49 | 1.89 | 0.00514 | 4.10 | 10.4 |
| | S-2 | 43.3 | 0.0694 | 0.326 | 5.60 | 46.3 | 6.65 | 1.72 | 0.00414 | 3.61 | 9.10 |
| | RPD | 66.7 | 21.8 | 11.5 | 16.0 | 2.51 | 19.1 | 9.36 | 21.3 | 12.7 | 13.7 |
| 042408-A | S-1 | 64.0 | 0.199 | 1.23 | 120 | 158 | 1.89 | 16.7 | 0.0101 | 0.321 | 32.8 |
| | S-2 | 83.1 | 0.210 | 1.44 | 101 | 181 | 1.32 | 14.9 | 0.0113 | 0.318 | 30.0 |
| | RPD | 25.9 | 5.45 | 15.4 | 17.3 | 13.6 | 35.7 | 11.4 | 10.9 | 1.15 | 8.73 |
| 022308-A | S-1 | 34.0 | 0.129 | 0.393 | 11.6 | 36.2 | 0.446 | 3.09 | 0.00567 | 0.419 | 11.5 |
| | S-2 | 29.8 | 0.0990 | 0.385 | 15.3 | 40.3 | 0.517 | 3.59 | 0.00667 | 0.528 | 8.76 |
| | RPD | 12.9 | 26.7 | 2.03 | 27.8 | 10.6 | 14.7 | 15.0 | 16.2 | 23.0 | 27.0 |
| 012508-A | S-1 | 31.1 | 0.184 | 1.55 | 8.10 | 72.7 | 0.326 | 2.66 | 0.00202 | 0.199 | 12.1 |
| | S-2 | 27.6 | 0.196 | 1.40 | 7.57 | 81.2 | 0.280 | 2.52 | 0.00151 | 0.192 | 13.6 |
| | RPD | 12.0 | 6.37 | 10.6 | 6.75 | 11.0 | 15.3 | 5.51 | 29.0 | 3.80 | 11.2 |
| 031308-A | S-1 | 24.0 | 0.112 | 0.677 | 19.7 | 73.5 | 11.3 | 3.74 | 0.01004 | 4.55 | 18.5 |
| | S-2 | 24.9 | 0.106 | 0.563 | 17.1 | 68.4 | 11.3 | 3.04 | 0.00900 | 4.09 | 18.4 |
| | RPD | 3.64 | 5.10 | 18.4 | 14.0 | 7.17 | 0.635 | 20.6 | 14.1 | 10.5 | 0.602 |
| 082208-B | S-1 | 23.0 | 0.103 | 0.518 | 60.5 | 74.1 | 4.21 | 2.88 | 0.0155 | 2.02 | 16.9 |
| | S-2 | 16.4 | 0.088 | 0.576 | 61.1 | 70.2 | 5.97 | 3.68 | 0.0124 | 2.03 | 15.5 |
| | RPD | 33.7 | 15.5 | 10.6 | 0.874 | 5.44 | 34.6 | 24.3 | 22.3 | 0.636 | 8.20 |

(to be continued)

(continued)

| Sample ID | Duplicate Splits | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 082808-B | S-1 | 15.9 | 0.0940 | 2.10 | 31.4 | 69.0 | 6.45 | 1.84 | 0.00859 | 4.42 | 9.87 |
| | S-2 | 14.7 | 0.102 | 2.38 | 38.1 | 65.5 | 6.70 | 2.19 | 0.00673 | 5.33 | 8.91 |
| | RPD | 7.95 | 7.89 | 12.7 | 19.1 | 5.20 | 3.89 | 17.3 | 24.4 | 18.6 | 10.3 |
| 090308-B | S-1 | 23.7 | 0.0772 | 0.205 | 90.6 | 57.3 | 6.27 | 2.64 | 0.00858 | 6.71 | 13.1 |
| | S-2 | 25.4 | 0.0780 | 0.247 | 89.8 | 62.5 | 8.84 | 2.28 | 0.00976 | 6.49 | 10.9 |
| | RPD | 6.91 | 1.04 | 18.6 | 0.883 | 8.68 | 34.1 | 14.6 | 12.8 | 3.28 | 18.1 |
| 090908-B | S-1 | -[b] | 0.0985 | 0.584 | 19.7 | 36.2 | 2.35 | 8.70 | 0.00434 | 1.28 | 6.46 |
| | S-2 | - | 0.120 | 0.419 | 20.8 | 37.9 | 2.78 | 7.64 | 0.00390 | 1.31 | 6.47 |
| | RPD | - | 19.8 | 33.0 | 5.43 | 4.55 | 16.6 | 12.9 | 10.8 | 2.55 | 0.192 |
| 091508-B | S-1 | - | 0.0525 | 0.0473 | 2.74 | 26.9 | 0.713 | 1.62 | 0.00830 | 0.059 | 4.37 |
| | S-2 | - | 0.0443 | 0.0391 | 2.37 | 29.6 | 0.827 | 1.72 | 0.00971 | 0.072 | 3.72 |
| | RPD | - | 16.9 | 18.8 | 14.3 | 9.27 | 14.7 | 5.74 | 15.7 | 19.5 | 16.3 |
| 092108-B | S-1 | 16.7 | 0.173 | 0.421 | 32.4 | 68.6 | 5.11 | 6.07 | 0.00609 | 4.85 | 14.4 |
| | S-2 | 17.1 | 0.145 | 0.366 | 32.9 | 83.8 | 5.61 | 5.00 | 0.00449 | 4.85 | 11.7 |
| | RPD | 2.71 | 17.2 | 14.1 | 1.50 | 20.0 | 9.30 | 19.3 | 30.3 | 0.0396 | 21.3 |
| 080408-C | S-1 | 9.87 | 0.0968 | 0.309 | 9.66 | 42.9 | 0.830 | 2.71 | 0.0100 | 0.0706 | 6.05 |
| | S-2 | 13.3 | 0.0749 | 0.218 | 8.07 | 31.4 | 1.28 | 3.65 | 0.00855 | 0.0625 | 6.43 |
| | RPD | 29.3 | 25.5 | 34.8 | 18.0 | 31.0 | 42.5 | 29.7 | 15.9 | 12.2 | 6.17 |
| | Mean RPD | 17.5 | 12.3 | 17.7 | 12.0 | 10.5 | 18.2 | 15.0 | 17.6 | 8.74 | 12.8 |

[a] S-1: Air concentrations of trace metals in sample split-1; S-2: Air concentrations of trace metals in sample split-2.

[b] Air concentrations less than filter blank

Table 4. Recovery of SRM 2783.

| Elements | Measured concentrations by ICP-MS (ppm) | Calculated concentrations of Reference Material (ppm) | Recovery (%) |
|---|---|---|---|
| Al | 1384 | 1519 | 91.1 |
| Cr | 7.44 | 8.84 | 84.1 |
| Cu | 24.3 | 26.5 | 92.0 |
| Fe | 1675 | 1735 | 96.6 |
| Ni | 2.07 | 4.45 | 46.4 |
| Pb | 21.0 | 20.8 | 101 |
| V | 2.89 | 3.18 | 90.8 |
| Zn | 121 | 117 | 103 |

Table 5. Recovery of SRM 1648a.

| Elements | Measured concentrations [a] by ICP-MS | | | | Certificate Concentrations [a] | Recovery (%) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | S-1[b] | S-2[b] | S-3[b] | S-4[b] | | S-1 | S-2 | S-3 | S-4 |
| Al | 3.74% | 3.88% | 3.75% | 3.81% | 3.56% | 105 | 109 | 105 | 107 |
| Cd | 66.3 | 75.1 | 71.4 | 71.9 | 71.9 | 89.9 | 102 | 96.9 | 97.5 |
| Cr | 196 | 220 | 212 | 211 | 389 | 50.4 | 56.6 | 54.5 | 54.2 |
| Cu | 651 | 643 | 647 | 668 | 668 | 107 | 105 | 106 | 110 |
| Fe | 4.08% | 4.36% | 4.23% | 4.31% | 4.31% | 99 | 106 | 103 | 104 |
| Ni | 119 | 117 | 118 | 124 | 87.9 | 135 | 133 | 135 | 141 |
| Pb | 0.600% | 0.64% | 0.620% | 0.660% | 0.660% | 91 | 98 | 95 | 101 |
| V | 143 | 146 | 139 | 146 | 138 | 103 | 106 | 101 | 106 |
| Zn | 5085 | 5297 | 5158 | 5235 | 5070 | 100 | 105 | 102 | 103 |

[a] Concentration is in mg $kg^{-1}$, unless noted as %;
[b] S-1, S-2, S-3, S-4 denote four replicates

Table 6. Completeness (%) of ICP-MS measurements.

| | Platform A | | | Platform B | | | Platform C | | |
|---|---|---|---|---|---|---|---|---|---|
| **Elements** | P.M.[a] | V.M.[b] | Completeness | P.M. | V.M. | Completeness | P.M. | V.M. | Completeness |
| Al | 83 | 83 | 100 | 60 | 67 | 90 | 82 | 82 | 100 |
| Cd | 83 | 83 | 100 | 65 | 67 | 97 | 82 | 82 | 100 |
| Cr | 83 | 83 | 100 | 65 | 67 | 97 | 82 | 82 | 100 |
| Cu | 83 | 83 | 100 | 65 | 67 | 97 | 82 | 82 | 100 |
| Fe | 83 | 83 | 100 | 65 | 67 | 97 | 80 | 82 | 98 |
| Ni | 73 | 83 | 88 | 60 | 67 | 90 | 75 | 82 | 91 |
| Pb | 82 | 83 | 99 | 64 | 67 | 96 | 81 | 82 | 99 |
| Sc | 82 | 83 | 99 | 63 | 67 | 94 | 81 | 82 | 99 |
| V | 83 | 83 | 100 | 65 | 67 | 97 | 81 | 82 | 99 |
| Zn | 83 | 83 | 100 | 65 | 67 | 97 | 80 | 82 | 98 |

[a] Number of planned measurements

[b] Number of valid measurements

Table 7. Averaged concentrations (ng $m^{-3}$) of trace metals at three platforms from time series sampling.

| Elements | Platform A | | Platform B | | Platform C | |
|---|---|---|---|---|---|---|
| | Concentration | N[a] | Concentration | N | Concentration | N |
| Al | 27.3 | 59 | 21.9 | 42 | 21.5 | 58 |
| Cd | 0.107 | 59 | 0.0966 | 45 | 0.0829 | 58 |
| Cr | 0.786 | 59 | 0.567 | 45 | 0.622 | 58 |
| Cu | 39.0 | 59 | 30.2 | 45 | 22.3 | 58 |
| Fe | 86.6 | 59 | 58.2 | 45 | 62.3 | 57 |
| Ni | 7.79 | 54 | 6.61 | 42 | 8.09 | 54 |
| Pb | 3.26 | 59 | 3.01 | 44 | 2.95 | 58 |
| Sc | 0.00711 | 59 | 0.00776 | 45 | 0.00846 | 58 |
| V | 2.84 | 59 | 2.30 | 45 | 2.93 | 58 |
| Zn | 14.7 | 59 | 18.1 | 45 | 15.6 | 58 |

[a] Number of samples

Table 8. Seasonal concentration gradients of trace metals and standard deviation at three platforms.

| Elements | Fall | | | Winter | | | Spring | | | Summer | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Platform | | | Platform | | | Platform | | | Platform | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Al | 11.5 | 11.6 | 18.2 | 15.0 | 14.6 | 17.7 | 37.2 | 29.5 | 27.5 | 40.1 | 24.8 | 22.7 |
| Cd | 0.0833 | 0.0902 | 0.148 | 0.0998 | 0.0796 | 0.0430 | 0.105 | 0.0539 | 0.0283 | 0.127 | 0.153 | 0.132 |
| Cr | 0.536 | 0.356 | 0.771 | 0.613 | 0.448 | 0.444 | 0.796 | 0.735 | 0.752 | 1.07 | 0.695 | 0.432 |
| Cu | 17.7 | 17.1 | 38.8 | 15.1 | 10.2 | 12.4 | 63.1 | 24.4 | 15.3 | 58.9 | 55.5 | 29.9 |
| Fe | 68.3 | 46.7 | 83.1 | 61.2 | 51.9 | 50.6 | 90.5 | 75.3 | 70.0 | 77.7 | 56.4 | 54.8 |
| Ni | 9.64 | 10.0 | 12.8 | 7.38 | 7.06 | 7.81 | 8.99 | 7.44 | 7.80 | 5.20 | 4.24 | 4.39 |
| Pb | 2.09 | 1.74 | 3.48 | 3.50 | 2.64 | 3.11 | 3.70 | 3.34 | 3.10 | 3.05 | 3.27 | 2.32 |
| Sc | 0.00615 | 0.00880 | 0.00794 | 0.00486 | 0.00539 | 0.0133 | 0.0101 | 0.00841 | 0.00763 | 0.00825 | 0.00884 | 0.00551 |
| V | 2.11 | 2.11 | 4.36 | 3.00 | 1.63 | 2.63 | 2.78 | 1.86 | 2.36 | 3.30 | 3.01 | 2.92 |
| Zn | 12.9 | 14.2 | 22.3 | 15.4 | 15.3 | 15.2 | 20.3 | 17.4 | 17.6 | 10.4 | 25.9 | 9.93 |

Table 9. Weekday and weekend concentration variations of trace metals at three platforms (ng $m^{-3}$).

| | Elements | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|---|---|
| **Platform A** | Al | 30.3 | 28.7 | 19.7 | 37.4 | 29.4 | 32.4 | 14.3 |
| | Cd | 0.141 | 0.150 | 0.0875 | 0.0930 | 0.105 | 0.0896 | 0.0859 |
| | Cr | 0.964 | 0.859 | 0.957 | 0.596 | 0.959 | 0.688 | 0.474 |
| | Cu | 25.1 | 38.7 | 35.5 | 50.3 | 45.3 | 40.3 | 38.9 |
| | Fe | 78.6 | 87.9 | 167 | 80.6 | 97.0 | 53.4 | 45.7 |
| | Ni | 11.5 | 5.93 | 11.2 | 7.60 | 8.86 | 4.24 | 6.15 |
| | Pb | 3.25 | 3.94 | 2.58 | 4.51 | 3.11 | 2.54 | 2.94 |
| | Sc | 0.00669 | 0.00647 | 0.00873 | 0.00699 | 0.00949 | 0.00561 | 0.00568 |
| | V | 3.87 | 2.67 | 2.91 | 2.42 | 3.69 | 1.31 | 2.76 |
| | Zn | 17.0 | 13.7 | 16.8 | 17.8 | 17.4 | 8.66 | 11.4 |
| **Platform B** | Al | 13.3 | 28.5 | 22.0 | 23.3 | 25.3 | 17.3 | 18.5 |
| | Cd | 0.0738 | 0.120 | 0.152 | 0.0759 | 0.0647 | 0.0938 | 0.109 |
| | Cr | 0.556 | 0.550 | 0.611 | 0.767 | 0.624 | 0.383 | 0.410 |
| | Cu | 35.0 | 23.1 | 30.3 | 24.9 | 35.8 | 22.9 | 39.3 |
| | Fe | 49.2 | 58.9 | 74.0 | 71.5 | 67.6 | 34.3 | 45.7 |
| | Ni | 6.52 | 6.51 | 6.83 | 8.64 | 7.62 | 4.79 | 3.99 |
| | Pb | 2.32 | 3.23 | 2.88 | 3.74 | 2.40 | 3.06 | 3.46 |
| | Sc | 0.00918 | 0.00877 | 0.00798 | 0.00824 | 0.00891 | 0.00742 | 0.00499 |
| | V | 1.42 | 1.17 | 3.18 | 3.28 | 2.97 | 0.941 | 2.49 |
| | Zn | 10.7 | 14.0 | 36.1 | 17.6 | 19.3 | 12.5 | 13.8 |
| **Platform C** | Al | 15.5 | 24.9 | 23.8 | 21.1 | 30.9 | 17.8 | 16.8 |
| | Cd | 0.140 | 0.0475 | 0.128 | 0.0452 | 0.0832 | 0.0535 | 0.0727 |
| | Cr | 0.662 | 0.830 | 0.902 | 0.559 | 0.557 | 0.428 | 0.461 |
| | Cu | 13.1 | 27.9 | 22.8 | 29.6 | 30.8 | 14.7 | 18.5 |
| | Fe | 56.9 | 88.7 | 60.5 | 77.7 | 82.5 | 34.4 | 36.5 |
| | Ni | 9.66 | 8.12 | 10.1 | 7.91 | 9.38 | 5.45 | 6.18 |
| | Pb | 2.93 | 3.94 | 2.24 | 3.94 | 3.27 | 2.23 | 2.28 |
| | Sc | 0.00601 | 0.00805 | 0.00846 | 0.00779 | 0.00995 | 0.00667 | 0.0119 |
| | V | 2.90 | 3.63 | 2.86 | 3.10 | 4.11 | 1.32 | 2.55 |
| | Zn | 15.6 | 16.5 | 18.3 | 18.8 | 19.4 | 9.75 | 11.4 |

Table 10. Diurnal concentration variations of (ng m$^{-3}$) of trace metals at three platforms in intensive sampling.

| **Elements** | **Winter Day** Platform | | | **Winter Night** Platform | | | **Summer Day** Platform | | | **Summer Night** Platform | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Al | 53.7 | 27.9 | 27.0 | 36.3 | 35.8 | 34.6 | 75.7 | 54.4 | 42.3 | 55.9 | 47.7 | 38.5 |
| Cd | 0.156 | 0.150 | 0.0478 | 0.0946 | 0.220 | 0.0531 | 0.254 | 0.193 | 0.300 | 0.181 | 0.133 | 0.138 |
| Cr | 0.586 | 1.13 | 0.530 | 0.596 | 1.04 | 0.870 | 1.25 | 0.546 | 0.696 | 0.843 | 1.04 | 2.37 |
| Cu | 27.4 | 15.9 | 9.53 | 69.0 | 8.70 | 8.02 | 30.1 | 36.4 | 19.5 | 58.7 | 74.5 | 33.6 |
| Fe | 70.2 | 76.0 | 59.6 | 66.2 | 57.0 | 71.8 | 107 | 69.3 | 67.2 | 75.8 | 57.3 | 61.1 |
| Ni | 12.1 | 15.1 | 9.84 | 8.93 | 8.77 | 11.3 | 6.19 | 6.16 | 6.95 | 3.50 | 3.89 | 3.16 |
| Pb | 3.29 | 4.44 | 2.72 | 3.26 | 3.53 | 3.05 | 5.13 | 5.13 | 3.64 | 4.75 | 5.34 | 2.93 |
| Sc | 0.00765 | 0.0109 | 0.00778 | 0.00956 | 0.00613 | 0.00707 | 0.0164 | 0.0145 | 0.0128 | 0.0104 | 0.0111 | 0.00812 |
| V | 2.41 | 3.88 | 2.21 | 1.81 | 2.22 | 1.75 | 2.06 | 2.08 | 1.96 | 3.05 | 3.11 | 1.09 |
| Zn | 22.5 | 33.8 | 36.6 | 17.2 | 22.2 | 42.7 | 15.6 | 16.5 | 14.2 | 13.0 | 12.2 | 10.9 |

## Appendix I: Cross reference of field sample ID, laboratory ID, and analysis dates

### I-1: The first run of ICP-MS experiment in March 2008

| Platform A | | | Platform B | | | Platform C | | |
|---|---|---|---|---|---|---|---|---|
| F.S.[a] | L.S.[b] | Date [c] | F.S.[a] | L.S.[b] | Date [c] | F.S.[a] | L.S.[b] | Date [c] |
| 092107-A | 112 | 03/08/2008 | 092707-B | 98 | 03/08/2008 | 092107-C | 79 | 03/08/2008 |
| 092707-A | 113 | 03/08/2008 | 100307-B | 99 | 03/08/2008 | 092707-C | 80 | 03/08/2008 |
| 100307-A | 114 | 03/08/2008 | 100907-B | 100 | 03/08/2008 | 100307-C | 81 | 03/08/2008 |
| 100907-A | 115 | 03/08/2008 | 102707-B | 101 | 03/08/2008 | 100907-C | 82 | 03/08/2008 |
| 101507-A | 116 | 03/08/2008 | 110207-B | 102 | 03/08/2008 | 101507-C | 83 | 03/08/2008 |
| 102107-A | 117 | 03/08/2008 | 110807-B | 103 | 03/08/2008 | 102107-C | 84 | 03/08/2008 |
| 102707-A | 118 | 03/08/2008 | 111407-B | 104 | 03/08/2008 | 102707-C | 85 | 03/08/2008 |
| 110207-A | 119 | 03/08/2008 | 112007-B | 105 | 03/08/2008 | 110207-C | 86 | 03/08/2008 |
| 110807-A | 120 | 03/08/2008 | 112607-B | 106 | 03/08/2008 | 110807-C | 87 | 03/08/2008 |
| 111407-A | 121 | 03/08/2008 | 120207-B | 107 | 03/08/2008 | 111407-C | 88 | 03/08/2008 |
| 112007-A | 122 | 03/08/2008 | 120807-B | 108 | 03/08/2008 | 112007-C | 89 | 03/08/2008 |
| 112607-A | 123 | 03/08/2008 | 121407-B | 109 | 03/08/2008 | 112607-C | 90 | 03/08/2008 |
| 120207-A | 124 | 03/08/2008 | 122007-B | 110 | 03/08/2008 | 120207-C | 91 | 03/08/2008 |
| 120807-A | 125 | 03/08/2008 | 122607-B | 111 | 03/08/2008 | 120807-C | 92 | 03/08/2008 |
| 121407-A | 126 | 03/08/2008 | 011908-B | 137 | 03/08/2008 | 121407-C | 93 | 03/08/2008 |
| 122007-A | 127 | 03/08/2008 | | | | 122007-C | 94 | 03/08/2008 |
| 122607-A | 128 | 03/08/2008 | | | | 122607-C | 95 | 03/08/2008 |
| 010108-A | 129 | 03/08/2008 | | | | 010108-C | 96 | 03/08/2008 |
| 010708-A | 130 | 03/08/2008 | | | | 010708-C | 97 | 03/08/2008 |
| 011308-A | 138 | 03/08/2008 | | | | 011308-C | 135 | 03/08/2008 |
| 011908-A | 139 | 03/08/2008 | | | | 011908-C | 136 | 03/08/2008 |
| blank | 78 | 03/08/2008 | | | | | | |

[a] Field sample ID
[b] Laboratory sample ID
[c] Date of analysis

**I-2: The second run of ICP-MS experiment in August 2008**

| Platform A | | | Platform B | | | Platform C | | |
|---|---|---|---|---|---|---|---|---|
| F.S.[a] | L.S.[b] | Date [c] | F.S.[a] | L.S.[b] | Date [c] | F.S.[a] | L.S.[b] | Date [c] |
| 012508-A | 62 | 08/14/2008 | 012508-B | 141 | 08/14/2008 | 012508-C | 168 | 08/15/2008 |
| D-012908-A | 63 | 08/14/2008 | D-012908-B | 142 | 08/14/2008 | D-012908-C | 169 | 08/15/2008 |
| N-012908-A | 64 | 08/14/2008 | N-012908-B | 143 | 08/14/2008 | N-012908-C | 170 | 08/15/2008 |
| D-013008-A | 65 | 08/14/2008 | 022908-B | 144 | 08/14/2008 | D-013008-C | 171 | 08/15/2008 |
| N-013008-A | 66 | 08/14/2008 | 030608-B | 145 | 08/14/2008 | N-013008-C | 172 | 08/15/2008 |
| D-013108-A | 67 | 08/14/2008 | D-030708-B | 146 | 08/14/2008 | D-013108-C | 173 | 08/15/2008 |
| N-013108-A | 68 | 08/14/2008 | N-030708-B | 147 | 08/14/2008 | N-013108-C | 174 | 08/15/2008 |
| 020508-A | 69 | 08/14/2008 | D-030808-B | 148 | 08/14/2008 | 020508-C | 175 | 08/15/2008 |
| 021108-A | 70 | 08/14/2008 | N-030808-B | 149 | 08/14/2008 | 021108-C | 176 | 08/15/2008 |
| 021708-A | 71 | 08/14/2008 | D-030908-B | 150 | 08/14/2008 | 021708-C | 177 | 08/15/2008 |
| 022308-A | 72 | 08/14/2008 | N-030908-B | 151 | 08/15/2008 | 022308-C | 178 | 08/15/2008 |
| 022908-A | 73 | 08/14/2008 | 031308-B | 152 | 08/15/2008 | 022908-C | 179 | 08/15/2008 |
| 030608-A | 74 | 08/14/2008 | 031908-B | 153 | 08/15/2008 | 030608-C | 180 | 08/15/2008 |
| D-030708-A | 75 | 08/14/2008 | 032508-B | 154 | 08/15/2008 | D-030708-C | 181 | 08/15/2008 |
| N-030708-A | 76 | 08/14/2008 | 033108-B | 155 | 08/15/2008 | N-030708-C | 182 | 08/15/2008 |
| D-030808-A | 77 | 08/14/2008 | 040608-B | 156 | 08/15/2008 | D-030808-C | 183 | 08/15/2008 |
| N-030808-A | 78 | 08/14/2008 | 041208-B | 157 | 08/15/2008 | N-030808-C | 184 | 08/15/2008 |
| D-030908-A | 79 | 08/14/2008 | 041808-B | 158 | 08/15/2008 | D-030908-C | 185 | 08/15/2008 |
| N-030908-A | 80 | 08/14/2008 | 042408-B | 159 | 08/15/2008 | N-030908-C | 186 | 08/15/2008 |
| 031308-A | 81 | 08/14/2008 | 043008-B | 160 | 08/15/2008 | 031308-C | 187 | 08/15/2008 |
| 031908-A | 82 | 08/14/2008 | 050608-B | 161 | 08/15/2008 | 031908-C | 188 | 08/15/2008 |
| 032508-A | 83 | 08/14/2008 | 051208-B | 162 | 08/15/2008 | 032508-C | 189 | 08/15/2008 |
| 033108-A | 84 | 08/14/2008 | 051808-B | 163 | 08/15/2008 | 033108-C | 190 | 08/15/2008 |
| 040608-A | 85 | 08/14/2008 | 052408-B | 164 | 08/15/2008 | 040608-C | 191 | 08/15/2008 |
| 041208-A | 86 | 08/14/2008 | 053008-B | 165 | 08/15/2008 | 041208-C | 192 | 08/15/2008 |
| 041208-A | 86 | 08/14/2008 | 060508-B | 166 | 08/15/2008 | 041808-C | 193 | 08/15/2008 |
| 041808-A | 87 | 08/14/2008 | 061108-B | 167 | 08/15/2008 | 042408-C | 194 | 08/15/2008 |
| 042408-A | 88 | 08/14/2008 | | | | 043008-C | 195 | 08/15/2008 |
| 043008-A | 89 | 08/14/2008 | | | | 050608-C | 196 | 08/15/2008 |
| 050608-A | 90 | 08/14/2008 | | | | 051208-C | 197 | 08/15/2008 |
| 051208-A | 135 | 08/14/2008 | | | | 051808-C | 198 | 08/15/2008 |
| 051808-A | 136 | 08/14/2008 | | | | 052408-C | 199 | 08/15/2008 |
| 052408-A | 137 | 08/14/2008 | | | | 053008-C | 200 | 08/15/2008 |
| 053008-A | 138 | 08/14/2008 | | | | 060508-C | 201 | 08/15/2008 |
| 060508-A | 139 | 08/14/2008 | | | | 061108-C | 202 | 08/15/2008 |
| 061108-A | 140 | 08/14/2008 | | | | | | |
| D-012908-blank | 61 | 08/14/2008 | | | | | | |

[a] Field Sample ID
[b] Laboratory sample ID
[c] Date of analysis

**I-3: The third run of ICP-MS experiment in October 2008**

| Platform A | | | Platform B | | | Platform C | | |
|---|---|---|---|---|---|---|---|---|
| F.S.[a] | L.S.[b] | Date[c] | F.S. | L.S. | Date | F.S. | L.S. | Date |
| 061708-A | 2 | 10/22/2008 | 061708-B | 16 | 10/22/2008 | 061708-C | 30 | 10/23/2008 |
| 062308-A | 3 | 10/22/2008 | 062308-B | 17 | 10/22/2008 | 062308-C | 31 | 10/23/2008 |
| 062908-A | 4 | 10/22/2008 | 062908-B | 18 | 10/23/2008 | 062908-C | 32 | 10/23/2008 |
| 070508-A | 5 | 10/22/2008 | 070508-B | 19 | 10/23/2008 | 070508-C | 33 | 10/23/2008 |
| 071108-A | 6 | 10/22/2008 | 071108-B | 20 | 10/23/2008 | 071108-C | 34 | 10/23/2008 |
| 072308-A | 7 | 10/22/2008 | 072308-B | 21 | 10/23/2008 | 072308-C | 35 | 10/23/2008 |
| D-071708-A | 8 | 10/22/2008 | D-071708-B | 22 | 10/23/2008 | D-071708-C | 36 | 10/23/2008 |
| N-071708-A | 9 | 10/22/2008 | N-071708-B | 23 | 10/23/2008 | N-071708-C | 37 | 10/23/2008 |
| D-071808-A | 10 | 10/22/2008 | D-071808-B | 24 | 10/23/2008 | D-071808-C | 38 | 10/23/2008 |
| N-071808-A | 11 | 10/22/2008 | N-071808-B | 25 | 10/23/2008 | N-071808-C | 39 | 10/23/2008 |
| D-071908-A | 12 | 10/22/2008 | D-071908-B | 26 | 10/23/2008 | D-071908-C | 40 | 10/23/2008 |
| N-071908-A | 13 | 10/22/2008 | N-071908-B | 27 | 10/23/2008 | N-071908-C | 41 | 10/23/2008 |
| D-072208-A | 14 | 10/22/2008 | D-072208-B | 28 | 10/23/2008 | D-072208-C | 42 | 10/23/2008 |
| N-072208-A | 15 | 10/22/2008 | N-072208-B | 29 | 10/23/2008 | N-072208-C | 43 | 10/23/2008 |
| D-072908-A | 44 | 10/23/2008 | D-072908-B | 57 | 10/24/2008 | D-072908-C | 70 | 10/24/2008 |
| N-072908-A | 45 | 10/23/2008 | N-072908-B | 58 | 10/24/2008 | N-072908-C | 71 | 10/24/2008 |
| 080408-A | 46 | 10/23/2008 | 080408-B | 59 | 10/24/2008 | 080408-C | 72 | 10/24/2008 |
| 081008-A | 47 | 10/23/2008 | 081008-B | 60 | 10/24/2008 | 081008-C | 73 | 10/24/2008 |
| 081608-A | 48 | 10/23/2008 | 081608-B | 61 | 10/24/2008 | 081608-C | 74 | 10/24/2008 |
| 082208-A | 49 | 10/23/2008 | 082208-B | 62 | 10/24/2008 | 082208-C | 75 | 10/24/2008 |
| 082808-A | 50 | 10/24/2008 | 082808-B | 63 | 10/24/2008 | 082808-C | 76 | 10/24/2008 |
| 090308-A | 51 | 10/24/2008 | 090308-B | 64 | 10/24/2008 | 090308-C | 77 | 10/24/2008 |
| D-090408-A | 52 | 10/24/2008 | D-090408-B | 65 | 10/24/2008 | D-090408-C | 78 | 10/24/2008 |
| N-090408-A | 53 | 10/24/2008 | N-090408-B | 66 | 10/24/2008 | N-090408-C | 79 | 10/24/2008 |
| 090908-A | 54 | 10/24/2008 | 090908-B | 67 | 10/24/2008 | 091508-C | 80 | 10/24/2008 |
| 091508-A | 55 | 10/24/2008 | 091508-B | 68 | 10/24/2008 | 092108-C | 81 | 10/24/2008 |
| 092108-A | 56 | 10/24/2008 | 092108-B | 69 | 10/24/2008 | | | |
| 071708-blank | 1 | 10/22/2008 | | | | | | |
| 092108-blank | 82 | 10/24/2008 | | | | | | |

[a] Field Sample ID
[b] Laboratory sample ID
[c] Date of analysis

## Appendix II: Trace metal concentrations (ng m$^{-3}$) in time series PM2.5 samples

II-1: Trace metal concentrations (ng m$^{-3}$) in time series PM2.5 samples at Platform A

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **092107-A** | 9.09 | 0.0258 | 0.204 | 4.89 | 157 | 8.86 | 1.09 | 0.00572 | 3.26 | 5.91 |
| **092707-A** | 10.6 | 0.0278 | 0.296 | 7.50 | 41.6 | 10.3 | 1.01 | 0.00612 | 2.30 | 7.53 |
| **100307-A** | 3.68 | 0.0249 | 0.355 | 32.2 | 39.2 | 12.4 | 0.963 | 0.00839 | 0.876 | 9.95 |
| **100907-A** | 16.4 | 0.0838 | 0.433 | 14.3 | 78.3 | 8.56 | 2.71 | 0.00689 | 0.866 | 14.9 |
| **101507-A** | 9.50 | 0.053 | 0.843 | 26.3 | 70.1 | 5.25 | 3.41 | 0.00428 | 0.143 | 6.97 |
| **102107-A** | 9.06 | 0.0858 | 0.422 | 11.9 | 54.9 | 9.42 | 3.12 | 0.00359 | 5.01 | 8.73 |
| **102707-A** | 3.01 | 0.0302 | 0.190 | 2.50 | 24.8 | 5.31 | 0.846 | 0.00393 | 0.423 | 2.75 |
| **110207-A** | 3.70 | 0.0196 | 0.990 | 17.7 | 43.4 | 6.72 | 0.599 | 0.00393 | 0.189 | 5.30 |
| **110807-A** | 45.6 | 0.0937 | 0.721 | 25.9 | 99.0 | 8.60 | 3.05 | 0.00690 | 1.01 | 23.1 |
| **111407-A** | 17.4 | 0.158 | 0.865 | 12.1 | 78.5 | 13.3 | 3.07 | 0.00742 | 6.50 | 18.6 |
| **112007-A** | 2.31 | 0.0478 | 0.587 | 30.7 | 63.3 | 7.50 | 2.25 | 0.00368 | 1.88 | 10.4 |
| **112607-A** | 8.07 | 0.349 | 0.525 | 26.6 | 68.8 | 19.4 | 2.99 | 0.0129 | 2.88 | 40.6 |
| **120207-A** | 2.14 | 0.0771 | 0.342 | 14.7 | 28.2 | 12.9 | 2.90 | 0.00656 | 0.884 | 27.2 |
| **120807-A** | 9.55 | 0.0944 | 0.421 | 18.1 | 61.1 | 5.36 | 2.84 | 0.00345 | 0.309 | 12.7 |
| **121407-A** | 2.86 | 0.0640 | 0.302 | 4.41 | 69.3 | 5.71 | 3.74 | 0.00296 | 0.168 | 19.3 |
| **122007-A** | 4.32 | 0.0515 | 0.403 | 19.8 | 77.3 | 8.13 | 2.10 | 0.00403 | 0.432 | 15.6 |
| **122607-A** | 3.17 | 0.0452 | 0.543 | 24.9 | 60.4 | 7.00 | 1.88 | 0.00370 | 0.503 | 11.0 |
| **010108-A** | 2.06 | 0.0403 | 0.877 | 1.47 | 24.2 | 5.57 | 1.14 | 0.00394 | 0.575 | 6.17 |
| **010708-A** | 19.8 | 0.172 | 1.86 | 19.6 | 152 | 24.5 | 9.25 | 0.00648 | 23.5 | 36.6 |
| **011308-A** | 3.53 | 0.0206 | 0.144 | 18.8 | 20.1 | 8.37 | 0.864 | 0.00565 | 0.422 | 10.7 |
| **011908-A** | 10.6 | 0.0754 | 0.148 | 1.60 | 23.7 | 3.91 | 1.95 | 0.00314 | 0.139 | 6.25 |
| **012508-A** | 31.1 | 0.184 | 1.55 | 8.10 | 72.7 | 0.326 | 2.66 | 0.00202 | 0.199 | 12.1 |
| **020508-A** | 43.1 | 0.362 | 1.32 | 71.9 | 189 | 14.7 | 15.0 | 0.00589 | 11.3 | 37.1 |
| **021108-A** | 23.3 | 0.0728 | 0.244 | 3.16 | 39.8 | -[a] | 2.28 | 0.00257 | 0.155 | 8.18 |
| **021708-A** | 20.0 | 0.0304 | 0.137 | 2.37 | 24.4 | 5.30 | 0.886 | 0.00857 | 2.97 | 5.87 |
| **022308-A** | 34.0 | 0.129 | 0.393 | 11.6 | 36.2 | 0.446 | 3.09 | 0.00567 | 0.419 | 11.5 |
| **022908-A** | 15.1 | 0.0781 | 0.504 | 5.37 | 39.9 | 8.66 | 1.95 | 0.00827 | 3.06 | 10.4 |
| **030608-A** | 32.3 | 0.127 | 0.697 | 57.2 | 104 | 12.7 | 2.85 | 0.0137 | 3.73 | 26.4 |
| **031308-A** | 24.0 | 0.112 | 0.677 | 19.7 | 73.5 | 11.3 | 3.74 | 0.0104 | 4.54 | 18.5 |
| **031908-A** | 21.6 | 0.0641 | 0.904 | 4.99 | 76.4 | 29.0 | 3.16 | 0.0260 | 6.02 | 53.2 |
| **032508-A** | 21.6 | 0.0864 | 0.366 | 6.57 | 47.5 | 5.49 | 1.89 | 0.00514 | 4.10 | 10.4 |
| **033108-A** | 19.3 | 0.213 | 1.14 | 13.3 | 68.6 | 11.0 | 1.89 | 0.00950 | 2.74 | 18.7 |
| **040608-A** | 3.08 | 0.0357 | 0.329 | 71.4 | 29.4 | 3.86 | 1.33 | 0.00405 | 0.832 | 11.7 |
| **041208-A** | 25.5 | 0.106 | 0.322 | 5.63 | 45.0 | 2.47 | 1.90 | 0.00298 | 2.52 | 6.26 |
| **041808-A** | 107 | 0.244 | 1.46 | 266 | 244 | 26.7 | 6.47 | 0.0380 | 8.79 | 53.1 |
| **042408-A** | 64.0 | 0.199 | 1.23 | 120 | 158 | 1.89 | 16.7 | 0.0101 | 0.321 | 32.8 |
| **043008-A** | 25.0 | 0.0850 | 0.995 | 59.6 | 108 | 0.923 | 3.81 | 0.00588 | 0.214 | 10.2 |
| **050608-A** | 70.9 | 0.0735 | 1.22 | 132 | 161 | 3.98 | 2.96 | 0.0114 | 1.27 | 11.8 |
| **051208-A** | 26.5 | 0.0122 | 1.01 | 46.8 | 51.2 | - | 0.711 | 0.00199 | 0.158 | 7.71 |

(to be continued)

(continued)

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **051808-A** | 24.0 | 0.0460 | 0.600 | 13.9 | 55.2 | 1.81 | 1.67 | 0.00348 | 2.09 | 9.31 |
| **052408-A** | 56.5 | 0.0520 | 0.373 | 103 | 50.6 | - | 2.81 | 0.000755 | 0.0835 | 9.80 |
| **053008-A** | 35.9 | 0.121 | 0.618 | 25.4 | 85.0 | 5.73 | 3.58 | 0.00755 | 4.36 | 23.9 |
| **060508-A** | 91.8 | 0.0200 | 0.242 | 85.2 | 36.6 | 2.35 | 1.67 | 0.000688 | 2.82 | 7.84 |
| **061108-A** | 15.3 | 0.0358 | 0.848 | 85.6 | 90.8 | - | 1.62 | 0.00108 | 0.114 | 6.72 |
| **061708-A** | 43.9 | 0.379 | 0.662 | 34.0 | 92.8 | 0.105 | 1.72 | 0.0117 | 0.139 | 9.58 |
| **062308-A** | 43.7 | 0.142 | 2.11 | 20.1 | 132 | 7.58 | 3.37 | 0.0128 | 5.18 | 16.5 |
| **062908-A** | 35.0 | 0.120 | 1.09 | 4.71 | 103 | 3.47 | 4.10 | 0.0129 | 3.71 | 11.1 |
| **070508-A** | 93.9 | 0.0875 | 3.15 | 112 | 117 | 11.1 | 4.11 | 0.0195 | 6.51 | 14.9 |
| **071108-A** | 34.2 | 0.0641 | 0.974 | 45.3 | 75.8 | 10.2 | 2.83 | 0.0130 | 11.2 | 14.1 |
| **072308-A** | 39.3 | 0.082 | 0.637 | 49.6 | 61.6 | 7.61 | 1.96 | 0.0145 | 2.52 | 14.0 |
| **080408-A** | 24.9 | 0.168 | 0.524 | 46.8 | 56.5 | 0.974 | 2.08 | 0.00491 | 0.0789 | 3.95 |
| **081008-A** | 20.6 | 0.154 | 0.644 | 117 | 34.3 | 5.67 | 3.42 | 0.00274 | 4.35 | 8.08 |
| **081608-A** | 26.5 | 0.142 | 0.503 | 67.6 | 68.7 | 1.13 | 2.77 | 0.00543 | 0.0788 | 5.02 |
| **082208-A** | 25.6 | 0.140 | 2.03 | 30.4 | 86.2 | 6.82 | 5.05 | 0.00395 | 1.95 | 12.8 |
| **082808-A** | 26.2 | 0.114 | 0.495 | 67.3 | 54.3 | 5.44 | 4.92 | 0.00403 | 4.23 | 10.6 |
| **090308-A** | 32.4 | 0.205 | 2.51 | 15.1 | 827 | 8.40 | 4.15 | 0.00298 | 6.50 | 10.8 |
| **090908-A** | 29.6 | 0.123 | 1.41 | 18.8 | 46.8 | 1.52 | 3.84 | 0.00317 | 1.23 | 9.02 |
| **091508-A** | 97.2 | 0.0859 | 0.432 | 23.6 | 68.9 | - | 3.27 | 0.00481 | 0.0411 | 13.4 |
| **092108-A** | 11.2 | 0.204 | 0.557 | 95.3 | 62.4 | 4.50 | 8.15 | 0.00356 | 4.54 | 9.80 |

[a] Air concentrations less than filter blank

II-2: Trace metal concentrations (ng $m^{-3}$) in time series PM2.5 samples at Platform B

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **092707-B** | 5.00 | 0.0189 | 0.0665 | 11.7 | 31.5 | 8.12 | 0.692 | 0.00785 | 2.65 | 6.84 |
| **100307-B** | 14.7 | 0.0323 | 0.674 | 28.6 | 56.7 | 9.20 | 1.16 | 0.0105 | 2.42 | 8.99 |
| **100907-B** | 16.0 | 0.0222 | 0.196 | 3.66 | 31.1 | 10.4 | 0.856 | 0.0136 | 0.779 | 11.5 |
| **102707-B** | 12.9 | 0.0304 | 0.0976 | 6.49 | 20.4 | 4.58 | 0.784 | 0.00713 | 0.412 | 2.79 |
| **110207-B** | 3.67 | 0.0218 | 0.0938 | 2.20 | 37.2 | 5.71 | 0.829 | 0.00582 | 0.204 | 6.69 |
| **110807-B** | 33.6 | 0.170 | 0.601 | 43.8 | 81.3 | 14.0 | 3.05 | 0.00806 | 7.15 | 19.2 |
| **111407-B** | 5.93 | 0.0572 | 0.613 | 24.0 | 81.0 | 7.18 | 2.83 | 0.00544 | 1.93 | 10.7 |
| **112007-B** | 5.93 | 0.380 | 0.501 | 24.8 | 55.2 | 17.9 | 2.75 | 0.0104 | 2.63 | 35.7 |
| **112607-B** | 6.48 | 0.0794 | 0.357 | 9.05 | 25.7 | 13.4 | 2.75 | 0.0104 | 0.835 | 25.9 |
| **120207-B** | 7.04 | 0.113 | 0.404 | 16.7 | 53.9 | 5.65 | 3.00 | 0.00541 | 0.335 | 11.7 |
| **120807-B** | 4.58 | 0.0640 | 0.208 | 14.5 | 56.1 | 5.55 | 3.92 | 0.00415 | 0.167 | 17.4 |
| **121407-B** | 7.16 | 0.0492 | 0.278 | 3.13 | 52.9 | 8.63 | 1.90 | 0.00702 | 0.389 | 14.6 |
| **122007-B** | 4.62 | 0.0475 | 0.462 | 3.41 | 53.5 | 7.24 | 1.40 | 0.00611 | 0.547 | 10.4 |
| **122607-B** | 43.0 | 0.0873 | 0.745 | 21.3 | 92.9 | 16.1 | 4.22 | 0.00892 | 8.42 | 18.4 |
| **011908-B** | 10.3 | 0.0778 | 0.175 | 1.74 | 21.1 | 4.81 | 1.91 | 0.00293 | 0.144 | 6.59 |
| **012508-B** | 24.2 | 0.130 | 0.646 | 3.81 | 44.5 | 0.573 | 2.25 | 0.00207 | 0.156 | 11.8 |
| **022908-B** | 16.0 | 0.0674 | 0.666 | 16.8 | 40.0 | 7.90 | 2.53 | 0.00651 | 2.85 | 32.0 |
| **030608-B** | 28.9 | 0.110 | 0.971 | 22.1 | 125 | 16.7 | 3.67 | 0.0133 | 4.66 | 34.1 |
| **031308-B** | 12.4 | 0.104 | 0.813 | 45.8 | 64.1 | 10.4 | 3.67 | 0.00464 | 4.36 | 16.7 |
| **031908-B** | 673 | 2.35 | 6.89 | 25.1 | 76.8 | 1420 | 1.19 | 0.774 | 5.67 | 44.5 |
| **032508-B** | 718 | 1.71 | 9.75 | 29.5 | 121 | 1210 | 1.08 | 1.04 | 6.03 | 45.5 |
| **033108-B** | 17.4 | 0.0847 | 1.64 | 44.2 | 81.0 | 11.6 | 1.81 | 0.0188 | 2.82 | 19.0 |
| **040608-B** | 11.7 | 0.0763 | 0.360 | 1.84 | 25.2 | 3.61 | 1.65 | 0.00695 | 0.827 | 13.9 |
| **041208-B** | -[a] | 0.0160 | 0.0413 | 0.0157 | 0.723 | - | - | 0.00208 | 0.0034 | 24.9 |
| **041808-B** | 64.9 | 0.0452 | 1.04 | 47.6 | 161 | 16.9 | 4.29 | 0.0243 | 6.00 | 39.1 |
| **042408-B** | 79.4 | 0.0595 | 1.04 | 12.0 | 122 | 3.99 | 14.8 | 0.0152 | 0.251 | 39.9 |
| **043008-B** | 29.4 | 0.127 | 0.771 | 5.61 | 87.9 | 0.706 | 3.35 | 0.00546 | 0.176 | 9.96 |
| **050608-B** | 57.9 | 0.0210 | 0.593 | 44.1 | 124 | 1.67 | 2.16 | 0.0113 | 1.06 | 8.10 |
| **051208-B** | 15.0 | 0.0441 | 0.276 | 2.23 | 43.7 | - | 0.309 | 0.00148 | 0.139 | 3.63 |
| **051808-B** | 5.69 | 0.00292 | 0.275 | 23.4 | 29.9 | 1.78 | 1.11 | 0.00187 | 1.54 | 4.31 |
| **052408-B** | 9.04 | 0.00752 | 0.380 | 34.1 | 50.9 | - | 1.52 | 0.00102 | 0.0606 | 2.24 |
| **053008-B** | 22.4 | 0.00333 | 1.35 | 34.8 | 62.7 | 7.09 | 1.76 | 0.00286 | 2.31 | 9.83 |
| **060508-B** | 6.39 | 0.00355 | 0.082 | 29.1 | 25.5 | 2.23 | 0.808 | 0.00217 | 2.20 | 4.13 |
| **061108-B** | 30.3 | 0.00393 | 0.660 | 14.3 | 74.3 | 0.161 | 1.70 | 0.00328 | 0.131 | 181 |
| **061708-B** | 34.3 | 0.0765 | 0.878 | 23.4 | 47.8 | 0.259 | 1.68 | 0.00420 | 0.0908 | 8.20 |
| **062308-B** | 10.9 | 0.0956 | 0.561 | 139 | 79.3 | 5.83 | 2.89 | 0.0135 | 4.59 | 7.42 |
| **062908-B** | 44.2 | 0.194 | 0.621 | 130 | 65.0 | 3.54 | 4.09 | 0.00674 | 3.59 | 11.9 |
| **070508-B** | 61.8 | 0.374 | 1.43 | 66.9 | 47.5 | 8.26 | 5.80 | 0.0130 | 5.73 | 15.2 |
| **071108-B** | 41.3 | 0.0976 | 0.407 | 118 | 68.2 | 9.98 | 2.77 | 0.00717 | 9.86 | 23.9 |
| **072308-B** | 7.13 | 0.678 | 0.609 | 27.3 | 68.3 | 8.16 | 4.26 | 0.0137 | 2.51 | 10.5 |

(to be continued)

(continued)

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **080408-B** | 16.7 | 0.0864 | 0.449 | 12.6 | 38.6 | 1.09 | 4.55 | 0.00263 | 0.0652 | 3.77 |
| **081008-B** | 25.5 | 0.0957 | 0.378 | 31.7 | 31.5 | 4.25 | 4.86 | 0.00290 | 3.81 | 26.7 |
| **081608-B** | 5.16 | 0.0874 | 0.345 | 36.5 | 43.5 | 0.757 | 4.41 | 0.0216 | 0.0686 | 18.1 |
| **082208-B** | 23.0 | 0.103 | 0.518 | 60.5 | 74.1 | 4.21 | 2.88 | 0.0155 | 2.02 | 16.9 |
| **082808-B** | 15.9 | 0.0940 | 2.10 | 31.4 | 69.0 | 6.45 | 1.84 | 0.00859 | 4.42 | 9.87 |
| **090308-B** | 23.7 | 0.0772 | 0.205 | 90.6 | 57.3 | 6.27 | 2.64 | 0.00858 | 6.70 | 13.1 |
| **090908-B** | - | 0.0985 | 0.584 | 19.7 | 36.2 | 2.35 | 8.70 | 0.00434 | 1.28 | 6.46 |
| **091508-B** | - | 0.0525 | 0.0473 | 2.73 | 26.9 | 0.713 | 1.62 | 0.00830 | 0.0593 | 4.37 |
| **092108-B** | 16.7 | 0.173 | 0.421 | 32.4 | 68.6 | 5.11 | 6.07 | 0.00609 | 4.85 | 14.4 |

[a] Air concentrations less than filter blank

II-3: Trace metal concentrations (ng m$^{-3}$) in time series PM2.5 samples at Platform C

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **092107-C** | 49.7 | 0.137 | 1.13 | 41.7 | 125 | 20.6 | 6.05 | 0.0135 | 11.4 | 25.1 |
| **092707-C** | 18.8 | 0.0580 | 0.555 | 32.5 | 74.1 | 13.7 | 2.35 | 0.00790 | 6.83 | 13.9 |
| **100307-C** | 12.4 | 0.0379 | 0.428 | 37.7 | 57.1 | 11.4 | 1.44 | 0.00766 | 3.21 | 11.3 |
| **100907-C** | 7.51 | 0.0374 | 0.377 | 2.96 | 44.7 | 13.9 | 1.47 | 0.00744 | 1.14 | 26.8 |
| **101507-C** | 10.4 | 0.0793 | 0.380 | 7.27 | 64.1 | 5.05 | 4.79 | 0.00360 | 0.201 | 9.35 |
| **102107-C** | 20.6 | 0.125 | 0.586 | 72.5 | 81.2 | 11.2 | 5.14 | 0.00632 | 7.97 | 15.6 |
| **102707-C** | 10.4 | 0.0577 | 0.620 | 13.1 | 28.6 | 7.00 | 1.19 | 0.00462 | 0.600 | 11.4 |
| **110207-C** | 5.77 | 0.0350 | 0.233 | 2.75 | 54.0 | 6.25 | 1.32 | 0.00431 | 0.326 | 9.96 |
| **110807-C** | 36.7 | 0.106 | 0.808 | 81.7 | 121 | 8.23 | 3.59 | 0.0115 | 1.14 | 21.9 |
| **111407-C** | 29.3 | 0.278 | 1.59 | 95.5 | 127 | 19.3 | 5.12 | 0.0107 | 11.8 | 43.2 |
| **112007-C** | 8.53 | 0.0942 | 1.35 | 48.3 | 131 | 9.01 | 4.69 | 0.00387 | 3.31 | 18.9 |
| **112607-C** | 8.53 | 0.729 | 1.20 | 29.1 | 89.6 | 27.5 | 4.62 | 0.0138 | 4.36 | 59.9 |
| **120207-C** | 29.6 | 0.0773 | 0.254 | 8.85 | 19.6 | 13.7 | 2.74 | 0.0741 | 0.858 | 27.6 |
| **120807-C** | 6.34 | 0.0970 | 0.479 | 13.1 | 39.5 | 5.75 | 2.83 | 0.0295 | 0.355 | 12.7 |
| **121407-C** | 8.48 | 0.0605 | 0.241 | 14.7 | 48.1 | 5.54 | 3.82 | 0.0191 | 0.178 | 15.5 |
| **122007-C** | 2.74 | 0.0458 | 0.204 | 2.71 | 37.3 | 7.41 | 1.81 | 0.0143 | 0.367 | 12.6 |
| **122607-C** | 33.3 | 0.0470 | 0.381 | 13.4 | 34.6 | 6.14 | 1.68 | 0.0119 | 0.499 | 16.4 |
| **010108-C** | 3.14 | 0.0481 | 0.704 | 3.49 | 17.3 | 5.32 | 1.09 | 0.0103 | 0.576 | 4.69 |
| **010708-C** | 22.2 | 0.140 | 1.44 | 35.9 | 130 | 21.4 | 7.79 | 0.0115 | 18.5 | 30.5 |
| **011308-C** | 2.09 | 0.0219 | 0.287 | 1.17 | 15.0 | 8.56 | 0.981 | 0.00395 | 0.435 | 11.0 |
| **011908-C** | 9.24 | 0.0812 | 0.113 | 1.88 | 20.8 | 4.37 | 2.07 | 0.00332 | 0.150 | 6.33 |
| **012508-C** | 11.0 | 0.00464 | 0.315 | 3.38 | 42.2 | 0.00319 | 2.14 | 0.000697 | 0.169 | 11.4 |
| **020508-C** | 64.5 | 0.00794 | 1.07 | 45.6 | 180 | 13.0 | 13.0 | 0.00559 | 10.8 | 36.5 |
| **021108-C** | 20.7 | 0.00178 | 0.261 | 1.53 | 29.0 | -[a] | 2.08 | 0.00152 | 0.165 | 6.40 |
| **021708-C** | 12.9 | 0.00212 | 0.156 | 12.7 | 26.4 | 6.06 | 0.854 | 0.00475 | 2.98 | 8.75 |
| **022308-C** | 11.4 | 0.00735 | 0.300 | 4.86 | 40.5 | 6.83 | 1.84 | 0.00124 | 0.385 | 14.1 |
| **022908-C** | 28.0 | 0.00278 | 0.447 | 22.2 | 78.4 | 13.0 | 1.95 | 0.00776 | 3.00 | 13.8 |
| **030608-C** | 23.8 | 0.00551 | 0.820 | 15.3 | 110 | 13.0 | 2.34 | 0.00534 | 3.42 | 27.9 |
| **031308-C** | 14.6 | 0.0463 | 0.662 | 25.9 | 61.6 | 9.76 | 2.90 | 0.00745 | 4.23 | 16.1 |
| **031908-C** | 20.8 | 0.0309 | 0.471 | 3.49 | 64.0 | 25.4 | 2.52 | 0.0203 | 5.07 | 42.9 |
| **032508-C** | 16.3 | 0.0284 | 0.314 | 21.2 | 40.4 | 4.77 | 1.84 | 0.00529 | 3.27 | 9.32 |
| **033108-C** | 21.8 | 0.0294 | 1.03 | 25.6 | 64.7 | 11.1 | 2.00 | 0.00655 | 2.59 | 17.9 |
| **040608-C** | 3.38 | 0.0242 | 0.241 | 1.54 | 19.3 | 3.52 | 1.00 | 0.00231 | 0.595 | 9.99 |
| **041208-C** | 24.0 | 0.0247 | 0.615 | 8.07 | 40.8 | 4.60 | 2.21 | 0.00359 | 2.34 | 12.9 |
| **041808-C** | 74.8 | 0.0151 | 1.38 | 16.1 | 176 | 18.2 | 4.50 | 0.0232 | 6.57 | 40.6 |
| **042408-C** | 45.3 | 0.0234 | 0.674 | 22.2 | 108 | 1.58 | 15.6 | 0.00890 | 0.278 | 38.5 |
| **043008-C** | 31.1 | 0.0233 | 1.07 | 6.90 | 80.3 | 0.583 | 3.36 | 0.00584 | 0.184 | 12.5 |
| **050608-C** | 57.9 | 0.0474 | 1.59 | 12.8 | 120 | 1.79 | 2.39 | 0.0103 | 1.12 | 9.93 |
| **051208-C** | 14.4 | 0.0276 | 0.612 | 2.23 | 41.7 | - | 0.279 | 0.00238 | 0.132 | 3.01 |
| **051808-C** | 10.8 | 0.0713 | 0.657 | 14.1 | 27.2 | 1.52 | 1.11 | 0.00150 | 1.54 | 4.61 |
| **052408-C** | 15.4 | 0.00979 | 0.448 | 13.4 | 22.0 | - | 1.53 | 0.00329 | 0.0406 | 1.89 |

(to be continued)

(continued)

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **053008-C** | 38.0 | 0.0173 | 0.689 | 40.2 | 73.9 | 5.61 | 2.87 | 0.00820 | 4.00 | 15.9 |
| **060508-C** | 11.1 | 0.0200 | 0.125 | 13.2 | 33.0 | 2.69 | 0.903 | 0.00190 | 2.59 | 5.16 |
| **061108-C** | 15.9 | 0.0177 | 0.395 | 7.98 | 65.3 | - | 1.33 | 0.00373 | 0.104 | 4.71 |
| **061708-C** | 16.7 | 0.0688 | 0.409 | 61.1 | 87.3 | 8.97 | 3.09 | 0.0135 | 5.17 | 9.44 |
| **062308-C** | 24.5 | 0.0720 | 0.385 | 6.86 | 46.8 | 0.462 | 1.91 | 0.00352 | 0.0788 | 4.55 |
| **062908-C** | 15.0 | 0.0805 | 0.324 | 0.415 | - | 0.603 | 0.527 | 0.00243 | 0.0101 | 1.31 |
| **070508-C** | 47.4 | 0.0978 | 0.511 | 37.1 | 44.2 | 8.74 | 3.77 | 0.00752 | 6.60 | 12.0 |
| **071108-C** | 34.2 | 0.137 | 0.247 | 81.9 | 61.5 | 9.73 | 2.17 | 0.00554 | 9.07 | 14.7 |
| **072308-C** | 43.2 | 0.585 | 0.498 | 15.9 | 42.9 | 6.98 | 1.55 | 0.00594 | 2.00 | 11.7 |
| **080408-C** | 9.87 | 0.0968 | 0.309 | 9.66 | 42.9 | 0.83 | 2.71 | 0.0100 | 0.0706 | 6.05 |
| **081008-C** | 14.8 | 0.0943 | 1.12 | 30.1 | 34.0 | 5.11 | 3.22 | 0.00505 | 4.00 | 10.9 |
| **081608-C** | 18.5 | 0.0524 | 0.343 | 26.3 | 39.2 | 0.893 | 2.4 | 0.000301 | 0.0592 | 6.76 |
| **082208-C** | 28.1 | 0.340 | 0.331 | 54.2 | 83.9 | 5.38 | 4.58 | 0.00722 | 2.30 | 27.3 |
| **082808-C** | 16.0 | 0.0571 | 0.627 | 43.7 | 76.3 | 6.88 | 1.97 | 0.00496 | 5.95 | 14.7 |
| **090308-C** | 4.27 | 0.00255 | 2.38 | 1.21 | 13.4 | 1.16 | 0.873 | 0.00156 | 0.0607 | 3.58 |
| **091508-C** | 6.88 | 0.0856 | 0.344 | 0.214 | 3.60 | 1.32 | 0.195 | 0.00114 | 0.0124 | 2.44 |
| **092108-C** | 42.4 | 0.158 | 0.529 | 25.4 | 69.0 | 5.26 | 4.91 | 0.00676 | 4.60 | 12.7 |

[a] Air concentrations less than filter blank

## Appendix III: Trace metal concentrations (ng m$^{-3}$) in winter and summer intensive samples

III-1: Trace metal concentrations (ng m-3) in winter intensive PM2.5 samples at Platform A

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **D-012908-A** | 111 | 0.477 | 1.78 | 50.6 | 193 | 14.0 | 9.91 | 0.0137 | 8.26 | 48.2 |
| **N-012908-A** | 52.7 | 0.317 | 1.44 | 124 | 153 | 24.1 | 8.62 | 0.0235 | 8.57 | 45.5 |
| **D-013008-A** | 35.1 | 0.0814 | 0.326 | 3.30 | 42.1 | -[a] | 1.16 | 0.00567 | 0.201 | 10.1 |
| **N-013008-A** | 20.2 | 0.0732 | 0.837 | 56.9 | 77.3 | 0.128 | 1.62 | 0.00343 | 0.192 | 11.6 |
| **D-013108-A** | 43.6 | 0.130 | 0.490 | 2.93 | 52.4 | - | 2.65 | 0.00175 | 0.147 | 8.91 |
| **N-013108-A** | 71.7 | 0.0892 | 0.382 | 161 | 63.1 | 7.90 | 4.05 | 0.00948 | 1.32 | 24.4 |
| **D-030708-A** | 99.6 | 0.0752 | 0.489 | 65.1 | 74.5 | 14.6 | 2.92 | 0.0179 | 3.14 | 44.2 |
| **N-030708-A** | 41.1 | 0.0213 | 0.158 | 68.1 | 20.3 | 3.53 | 0.732 | 0.0106 | 0.617 | 13.2 |
| **D-030808-A** | 14.0 | 0.0892 | 0.38 | 39.7 | 33.8 | 7.58 | 2.13 | 0.00642 | 2.65 | 19.5 |
| **N-030808-A** | 4.20 | 0.0133 | 0.272 | 1.70 | 5.15 | - | - | 0.00084 | 0.0214 | 0.777 |
| **D-030908-A** | 18.6 | 0.0837 | 0.0495 | 2.60 | 25.6 | - | 0.988 | 0.000453 | 0.0902 | 4.01 |
| **N-030908-A** | 27.9 | 0.0532 | 0.486 | 2.49 | 78.3 | - | 1.28 | - | 0.148 | 7.62 |

[a] Air concentrations less than filter blank

III-2: Trace metal concentrations (ng $m^{-3}$) in winter intensive PM2.5 samples at Platform B

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **D-012908-B** | 36.5 | 0.432 | 2.17 | 48.4 | 174 | 14.4 | 10.5 | 0.0106 | 7.67 | 58.2 |
| **N-012908-B** | 22.8 | 0.263 | 1.23 | 23.7 | 136 | 21.2 | 9.32 | 0.0149 | 7.67 | 41.2 |
| **D-030708-B** | 25.4 | 0.0867 | 1.25 | 4.42 | 73.8 | 17.2 | 3.42 | 0.0133 | 3.73 | 40.3 |
| **N-030708-B** | 29.0 | 0.0297 | 0.343 | 3.90 | 23.5 | 4.40 | 1.32 | 0.00199 | 0.882 | 20.6 |
| **D-030808-B** | 21.7 | 0.0479 | 0.827 | 7.72 | 33.3 | 13.7 | 2.29 | 0.00897 | 4.04 | 29.5 |
| **N-030808-B** | 46.0 | 0.0722 | 1.51 | 4.23 | 28.4 | 0.683 | 1.77 | -[a] | 0.118 | 13.6 |
| **D-030908-B** | - | 0.0325 | 0.255 | 3.01 | 23.0 | - | 1.53 | - | 0.0985 | 7.24 |
| **N-030908-B** | 45.6 | 0.514 | 1.07 | 3.01 | 40.1 | - | 1.71 | 0.00146 | 0.218 | 13.3 |

[a] Air concentrations less than filter blank

III-3: Trace metal concentrations (ng $m^{-3}$) in winter intensive PM2.5 samples at Platform C

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **D-012908-C** | 80.0 | 0.00852 | 1.40 | 39.6 | 180 | 10.8 | 8.67 | 0.0100 | 6.64 | 48.4 |
| **N-012908-C** | 52.0 | 0.00763 | 1.58 | 28.4 | 164 | 23.7 | 8.15 | 0.0137 | 7.64 | 46.9 |
| **D-013008-C** | 15.9 | 0.0134 | 0.245 | 1.40 | 31.7 | -[a] | 0.841 | 0.00427 | 0.159 | 6.46 |
| **N-013008-C** | 8.91 | 0.0650 | 0.345 | 5.39 | 62.0 | - | 1.59 | 0.00287 | 0.146 | 16.8 |
| **D-013108-C** | 28.6 | 0.00707 | 0.704 | 2.34 | 49.6 | 0.416 | 1.70 | 0.00971 | 0.159 | 13.5 |
| **N-013108-C** | 44.8 | 0.00809 | 1.63 | 5.01 | 102 | 16.8 | 3.17 | 0.00977 | 1.53 | 138 |
| **D-030708-C** | 27.4 | 0.0164 | 0.534 | 4.69 | 55.4 | 17.6 | 3.10 | 0.0152 | 3.22 | 129 |
| **N-030708-C** | 20.4 | 0.142 | 0.393 | 2.34 | 27.5 | 5.80 | 1.54 | 0.00355 | 0.876 | 21.5 |
| **D-030808-C** | 9.28 | 0.190 | 0.279 | 8.17 | 24.2 | 10.6 | 1.17 | 0.00525 | 3.00 | 22.0 |
| **N-030808-C** | 67.7 | 0.0328 | 0.581 | 4.19 | 38.3 | 7.76 | 1.71 | 0.00549 | 0.139 | 18.1 |
| **D-030908-C** | 0.673 | 0.0508 | 0.0144 | 0.962 | 17.3 | - | 0.826 | 0.00227 | 0.104 | - |
| **N-030908-C** | 14.0 | 0.0627 | 0.685 | 2.76 | 37.3 | 2.21 | 2.15 | - | 0.189 | 15.3 |

[a] Air concentrations less than filter blank

III-4: Trace metal concentrations (ng $m^{-3}$) in summer intensive PM2.5 samples at Platform A

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **D-071708-A** | 96.2 | 0.201 | 3.33 | 63.5 | 203 | 5.39 | 5.49 | 0.0209 | 4.49 | 17.8 |
| **N-071708-A** | 54.6 | 0.0883 | 1.51 | 140 | 105 | 0.799 | 3.44 | 0.00993 | 0.375 | 13.2 |
| **D-071808-A** | 68.7 | 0.214 | 0.601 | 8.09 | 93.8 | 0.0589 | 5.12 | 0.0148 | 0.240 | 17.1 |
| **N-071808-A** | 72.4 | 0.223 | 0.974 | 4.59 | 79.1 | 0.883 | 4.96 | 0.0123 | 0.779 | 14.5 |
| **D-071908-A** | 77.3 | 0.367 | 0.572 | 3.81 | 67.5 | 0.549 | 4.86 | 0.0136 | 0.562 | 9.87 |
| **N-071908-A** | 6.66 | 0.180 | 0.457 | 10.1 | 63.8 | 1.81 | 3.74 | 0.0229 | 2.92 | 1.06 |
| **D-072208-A** | 5.81 | 0.254 | 0.564 | 63.8 | 94.8 | 18.3 | 4.55 | 0.0372 | 3.28 | 15.6 |
| **N-072208-A** | 90.6 | 0.0851 | 0.822 | 85.4 | 50.5 | 5.53 | 3.53 | 0.00929 | 2.36 | 25.6 |
| **D-072908-A** | 114 | 0.298 | 0.533 | 22.4 | 89.6 | 3.02 | 3.78 | 0.00208 | 0.399 | 11.1 |
| **N-072908-A** | 39.4 | 0.187 | 0.858 | 92.1 | 118 | 2.55 | 5.36 | 0.00540 | 0.254 | 16.6 |
| **D-090408-A** | 92.0 | 0.191 | 1.92 | 18.6 | 94.7 | 9.80 | 6.94 | 0.00991 | 3.37 | 22.1 |
| **N-090408-A** | 71.6 | 0.324 | 0.433 | 20.7 | 38.9 | 9.42 | 7.49 | 0.00277 | 11.6 | 6.86 |

III-5: Trace metal concentrations (ng $m^{-3}$) in summer intensive PM2.5 samples at Platform B

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **D-071708-B** | 54.1 | 0.202 | 0.496 | 76.9 | 89.3 | 5.07 | 5.97 | 0.0172 | 4.65 | 16.1 |
| **N-071708-B** | -[a] | 0.100 | 0.920 | 47.3 | 72.4 | 0.0849 | 7.00 | 0.0143 | 0.198 | 4.22 |
| **D-071808-B** | 66.5 | 0.234 | 0.394 | 25.4 | 59.3 | 0.465 | 4.70 | 0.0115 | 0.197 | 25.5 |
| **N-071808-B** | 63.9 | 0.0939 | 0.892 | 93.6 | 65.8 | 3.01 | 5.16 | 0.0129 | 0.826 | 15.5 |
| **D-071908-B** | 76.8 | 0.095 | 0.647 | 32.9 | 44.2 | 1.77 | 2.96 | 0.0128 | 0.515 | 9.64 |
| **N-071908-B** | 82.1 | 0.185 | 0.995 | 128 | 71.1 | 3.32 | 3.41 | 0.0188 | 3.62 | 14.9 |
| **D-072208-B** | 0.317 | 0.168 | 0.541 | 20.4 | 79.5 | 19.2 | 3.17 | 0.0358 | 3.24 | 15.7 |
| **N-072208-B** | 34.2 | 0.15 | 0.568 | 4.76 | 23.6 | 6.67 | 2.85 | 0.0103 | 2.28 | 17.5 |
| **D-072908-B** | 43.2 | 0.256 | 0.745 | 13.0 | 71.4 | 2.10 | 9.28 | 0.00237 | 0.377 | 12.2 |
| **N-072908-B** | 21.2 | 0.122 | 0.794 | 41.4 | 73.6 | 0.441 | 7.25 | 0.00201 | 0.179 | 6.53 |
| **D-090408-B** | 85.7 | 0.205 | 0.455 | 50.0 | 72.0 | 8.28 | 4.69 | 0.00745 | 3.49 | 20.0 |
| **N-090408-B** | 37.2 | 0.148 | 2.07 | 132 | 37.4 | 9.84 | 6.36 | 0.00816 | 11.6 | 14.3 |

[a] Air concentrations less than filter blank

III-6: Trace metal concentrations (ng $m^{-3}$) in summer intensive PM2.5 samples at Platform C

| Sample ID | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| **D-071708-C** | 43.7 | 0.210 | 1.14 | 32.4 | 80.3 | 5.37 | 3.71 | 0.0121 | 3.85 | 10.4 |
| **N-071708-C** | 41.1 | 0.148 | 0.455 | 35.0 | 55.1 | 1.47 | 2.61 | 0.00661 | 0.133 | 7.57 |
| **D-071808-C** | 57.5 | 0.0737 | 0.602 | 12.7 | 51.1 | 1.79 | 3.50 | 0.0100 | 0.212 | 10.5 |
| **N-071808-C** | 49.3 | 0.0898 | 0.781 | 43.5 | 59.6 | 2.16 | 4.47 | 0.0104 | 0.737 | 12.5 |
| **D-071908-C** | 38.6 | 0.596 | 0.54 | 11.1 | 40.5 | 2.03 | 2.59 | 0.00827 | 0.546 | 7.15 |
| **N-071908-C** | 54.3 | 0.101 | 0.961 | 70.1 | 61.8 | 3.03 | 3.11 | 0.00619 | 3.11 | 7.27 |
| **D-072208-C** | 30.5 | 0.558 | 0.589 | 12.4 | 76.8 | 19.7 | 3.85 | 0.0211 | 2.94 | 16.2 |
| **N-072208-C** | 53.0 | 0.307 | 10.7 | 2.97 | 77.5 | 7.26 | 2.32 | 0.0122 | 2.26 | 16.7 |
| **D-072908-C** | 23.6 | 0.238 | 0.195 | 8.82 | 53.5 | 2.19 | 5.03 | 0.0165 | 0.407 | 16.9 |
| **N-072908-C** | 26.8 | 0.115 | 0.843 | 50.0 | 112 | 2.85 | 5.03 | 0.0116 | 0.306 | 21.5 |
| **D-090408-C** | 60.0 | 0.123 | 1.11 | 39.3 | 101 | 10.6 | 3.17 | 0.00855 | 3.83 | 24.3 |
| **N-090408-C** | 6.57 | 0.0653 | 0.437 | 0.191 | -[a] | 2.21 | - | 0.00185 | - | - |

[a] Air concentrations less than filter blank

**Appendix IV: Cross reference of field sample ID and laboratory ID of MOUDI experiment***

| Winter Intensive Sampling | | | Summer Intensive Sampling | | |
|---|---|---|---|---|---|
| Date | Samples ID | ICP-MS ID | Date | Samples ID | ICP-MS ID |
| 12/11/2007-12/14/2007 | MT1-1 | 1 | 07/03/2008-07/07/2008 | I-e-1 | 214 |
| | MT1-2 | 2 | | I-e-2 | 215 |
| | MT1-3 | 3 | | I-e-3 | 216 |
| | MT1-4 | 4 | | I-e-4 | 217 |
| | MT1-5 | 5 | | I-e-5 | 218 |
| | MT1-6 | 6 | | I-e-6 | 219 |
| | MT1-7 | 7 | | I-e-7 | 220 |
| | MT1-8 | 8 | | I-e-8 | 221 |
| | MT1-9 | 9 | | I-e-9 | 222 |
| 12/14/2007-12/18/2007 | MT2-1 | 10 | 07/07/2008-07/11/2008 | II-e-1 | 234 |
| | MT2-2 | 11 | | II-e-2 | 235 |
| | MT2-3 | 12 | | II-e-3 | 236 |
| | MT2-4 | 13 | | II-e-4 | 237 |
| | MT2-5 | 14 | | II-e-5 | 238 |
| | MT2-6 | 15 | | II-e-6 | 239 |
| | MT2-7 | 16 | | II-e-7 | 240 |
| | MT2-8 | 17 | | II-e-8 | 241 |
| | MT2-9 | 18 | | II-e-9 | 242 |
| 12/18/2007-12/21/2007 | MT3-1 | 19 | 07/11/2008-07/15/2008 | III-e-1 | 254 |
| | MT3-2 | 20 | | III-e-2 | 255 |
| | MT3-3 | 21 | | III-e-3 | 256 |
| | MT3-4 | 22 | | III-e-4 | 257 |
| | MT3-5 | 23 | | III-e-5 | 258 |
| | MT3-6 | 24 | | III-e-6 | 259 |
| | MT3-7 | 25 | | III-e-7 | 260 |
| | MT3-8 | 26 | | III-e-8 | 261 |
| | MT3-9 | 27 | | III-e-9 | 262 |

(to be continued)

(continued)

| Winter Intensive Sampling | | | Summer Intensive Sampling | | |
|---|---|---|---|---|---|
| Date | Samples ID | ICP-MS ID | Date | Samples ID | ICP-MS ID |
| 1/29/2008-2/1/2008 | MT4-1 | 28 | 07/15/2008-07/19/2008 | IV-e-1 | 274 |
| | MT4-2 | 29 | | IV-e-2 | 275 |
| | MT4-3 | 30 | | IV-e-3 | 276 |
| | MT4-4 | 31 | | IV-e-4 | 277 |
| | MT4-5 | 32 | | IV-e-5 | 278 |
| | MT4-6 | 33 | | IV-e-6 | 279 |
| | MT4-7 | 34 | | IV-e-7 | 280 |
| | MT4-8 | 35 | | IV-e-8 | 281 |
| | MT4-9 | 36 | | IV-e-9 | 282 |
| 2/21/2008-2/24/2008 | MT 5-1 | 37 | 07/19/2008-07/23/2008 | V-e-1 | 294 |
| | MT 5-2 | 38 | | V-e-2 | 295 |
| | MT 5-3 | 39 | | V-e-3 | 296 |
| | MT 5-4 | 40 | | V-e-4 | 297 |
| | MT 5-5 | 41 | | V-e-5 | 298 |
| | MT 5-6 | 42 | | V-e-6 | 299 |
| | MT 5-7 | 43 | | V-e-7 | 300 |
| | MT 5-8 | 44 | | V-e-8 | 301 |
| | MT 5-9 | 45 | | V-e-9 | 302 |
| 2/24/2008-2/27/2008 | MB 4-1 | 46 | 07/19/2008-07/23/2008 | Blank | 202 |
| | MB 4-2 | 47 | | III-e-2 | 255 |
| | MB 4-3 | 48 | | | |
| | MB 4-4 | 49 | | | |
| | MB 4-5 | 50 | | | |
| | MB 4-6 | 51 | | | |
| | MB 4-7 | 52 | | | |
| | MB 4-8 | 53 | | | |
| | MB 4-9 | 54 | | | |
| 2/24/2008-2/27/2008 | MOUDI Blank | 143 | | | |

* The winter intensive samples extractions and determinations were conducted in March 11-14, 2008 and March 19-21, 2008. The summer intensive samples extractions and determinations were conducted in July 24-27, 2008 and July 28-Aug. 1, 2008.

## Appendix V: The size segregated air concentrations (ng $m^{-3}$) of trace metals during the winter and summer intensive sampling at platform A

V-1: Air concentrations (ng $m^{-3}$) of trace metals from the 1st set of winter intensive sampling (12/11/2007-12/14/2007)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14.0 | 13.7 | 0.00267 | 0.281 | 0.619 | 35.3 | 0.273 | 0.145 | 0.0118 | 0.0886 | 0.776 |
| 2 | 7.80 | 37.2 | 0.00800 | 0.275 | 5.10 | 67.1 | 0.329 | 0.366 | 0.0119 | 0.193 | 5.18 |
| 3 | 4.40 | 14.2 | 0.00630 | 0.292 | 3.11 | 65.4 | 0.372 | 0.539 | 0.00859 | 0.241 | 3.05 |
| 4 | 2.50 | 9.22 | 0.00893 | 0.144 | 1.63 | 40.8 | 0.368 | 0.271 | 0.00625 | 0.168 | 1.93 |
| 5 | 1.40 | 7.75 | 0.0256 | 0.262 | 1.82 | 42.7 | 0.485 | 0.801 | 0.00554 | 0.462 | 5.50 |
| 6 | 0.780 | 1.80 | 0.0234 | 0.180 | 0.584 | 12.7 | 0.562 | 0.875 | 0.00318 | 0.488 | 4.13 |
| 7 | 0.440 | 2.62 | 0.0202 | 0.126 | 0.487 | 7.71 | 0.744 | 1.08 | 0.00290 | 0.611 | 4.70 |
| 8 | 0.250 | -[a] | 0.0198 | 0.204 | 0.629 | 6.40 | 1.62 | 1.05 | 0.00265 | 1.24 | 8.92 |

[a] Air concentrations less than filter blank

V-2: Air concentrations (ng $m^{-3}$) of trace metals from the 2nd set of winter intensive sampling (12/14/2007-12/18/2007)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 12.4 | 0.00133 | 0.0626 | 0.373 | 21.0 | 0.481 | 0.0655 | 0.00322 | 0.0411 | 1.30 |
| 2 | 7.8 | 13.2 | 0.00469 | 0.110 | 0.808 | 26.3 | 0.221 | 0.101 | 0.00340 | 0.0563 | 1.51 |
| 3 | 4.4 | 19.2 | 0.00514 | 0.229 | 2.77 | 59.9 | 0.236 | 0.195 | 0.00621 | 0.104 | 2.43 |
| 4 | 2.5 | 10.1 | 0.00249 | 0.158 | 3.05 | 41.2 | 0.209 | 0.125 | 0.00462 | 0.0661 | 1.17 |
| 5 | 1.4 | 4.80 | 0.00671 | 0.134 | 5.34 | 34.1 | 0.185 | 0.367 | 0.00274 | 0.0487 | 1.86 |
| 6 | 0.78 | -[a] | 0.00756 | 0.0320 | 0.911 | 5.68 | 0.130 | 0.234 | 0.000930 | 0.0319 | 1.05 |
| 7 | 0.44 | - | 0.0179 | 0.0868 | 0.859 | 5.07 | 0.308 | 0.613 | 0.00116 | 0.109 | 3.54 |
| 8 | 0.25 | - | 0.00997 | 0.143 | 0.427 | 3.00 | 0.594 | 0.428 | 0.000934 | 0.127 | 4.08 |

[a] Air concentrations less than filter blank

V-3: Air concentrations (ng $m^{-3}$) of trace metals from the 3rd set of winter intensive sampling (12/18/2007-12/21/2007)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 49.6 | 0.00538 | 0.331 | 1.81 | 75.2 | 0.331 | 0.286 | 0.00939 | 0.211 | 2.63 |
| 2 | 7.8 | 51.4 | 0.00986 | 0.410 | 3.40 | 115 | 0.298 | 0.38 | 0.0111 | 0.289 | 3.08 |
| 3 | 4.4 | 13.3 | 0.00349 | 0.235 | 3.60 | 60.8 | 0.247 | 0.202 | 0.00504 | 0.205 | 1.54 |
| 4 | 2.5 | 15.0 | 0.00731 | 0.325 | 6.75 | 102 | 0.319 | 0.369 | 0.00444 | 0.252 | 3.14 |
| 5 | 1.4 | 15.7 | 0.0284 | 0.371 | 8.89 | 90.3 | 0.388 | 1.27 | 0.00486 | 0.279 | 7.49 |
| 6 | 0.78 | 4.94 | 0.0358 | 0.203 | 3.29 | 20.0 | 0.636 | 1.32 | 0.00165 | 0.331 | 6.16 |
| 7 | 0.44 | 0.158 | 0.0291 | 0.0984 | 1.60 | 6.89 | 0.547 | 1.12 | 0.00114 | 0.693 | 4.64 |
| 8 | 0.25 | -[a] | 0.0218 | 0.105 | 1.60 | 4.97 | 1.22 | 1.24 | 0.00141 | 1.79 | 7.67 |

[a] Air concentrations less than filter blank

V-4: Air concentrations (ng $m^{-3}$) of trace metals from the 4th set of winter intensive sampling (1/29/2008-2/1/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 22.7 | 0.00250 | 0.142 | 0.935 | 42.3 | 0.245 | 0.179 | 0.00553 | 0.134 | 0.920 |
| 2 | 7.8 | 52.3 | 0.00602 | 0.336 | 3.02 | 95.1 | 0.471 | 0.313 | 0.0111 | 0.264 | 2.42 |
| 3 | 4.4 | 75.7 | 0.00957 | 0.372 | 5.09 | 139 | 0.386 | 0.319 | 0.0120 | 0.339 | 2.44 |
| 4 | 2.5 | 56.4 | 0.00914 | 0.252 | 13.1 | 129 | 0.423 | 0.296 | 0.0076 | 0.246 | 2.93 |
| 5 | 1.4 | 16.6 | 0.0217 | 0.226 | 16.8 | 62.3 | 0.399 | 0.559 | 0.00435 | 0.198 | 4.08 |
| 6 | 0.78 | 4.17 | 0.0347 | 0.477 | 7.56 | 19.7 | 0.596 | 0.93 | 0.00234 | 0.316 | 4.41 |
| 7 | 0.44 | 4.23 | 0.0475 | 0.170 | 2.97 | 12.2 | 0.938 | 1.26 | 0.00188 | 0.776 | 5.95 |
| 8 | 0.25 | 2.97 | 0.0317 | 0.173 | 1.25 | 8.09 | 1.99 | 1.08 | 0.00221 | 1.54 | 7.03 |

V-5: Air concentrations (ng $m^{-3}$) of trace metals from the 5th set of winter intensive sampling (2/21/2008-2/14/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 9.32 | 0.00277 | 0.126 | 0.828 | 20.2 | 0.0893 | 0.144 | 0.00295 | 0.0384 | 0.878 |
| 2 | 7.8 | 23.7 | 0.0132 | 0.136 | 2.13 | 27.7 | 0.467 | 0.0933 | 0.00282 | 0.0594 | 3.22 |
| 3 | 4.4 | 13.3 | 0.145 | 0.185 | 3.73 | 37.2 | 0.202 | 0.102 | 0.00441 | 0.129 | 6.83 |
| 4 | 2.5 | 5.36 | 0.00242 | 0.0761 | 3.13 | 21.5 | 0.147 | 0.0529 | 0.00283 | 0.0752 | 0.539 |
| 5 | 1.4 | 5.23 | 0.00621 | 0.172 | 6.04 | 22.5 | 0.225 | 0.172 | 0.00351 | 0.0813 | 1.46 |
| 6 | 0.78 | 2.76 | 0.0101 | 0.140 | 4.28 | 8.81 | 0.251 | 0.310 | 0.00124 | 0.105 | 2.50 |
| 7 | 0.44 | 1.27 | 0.0103 | 0.0905 | 1.57 | 4.14 | 0.490 | 0.547 | 0.00108 | 0.264 | 2.59 |
| 8 | 0.25 | -[a] | 0.0113 | 0.134 | 0.904 | 4.32 | 1.16 | 0.517 | 0.00149 | 0.515 | 4.76 |

[a] Air concentrations less than filter blank

V-6: Air concentrations (ng $m^{-3}$) of trace metals from the 6th set of winter intensive sampling (2/24/2008-2/27/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 22.1 | 0.0112 | 0.119 | 0.635 | 30.4 | 0.252 | 0.133 | 0.00997 | 0.096 | 1.38 |
| 2 | 7.8 | 40.9 | 0.00636 | 0.230 | 1.91 | 77.2 | 0.278 | 0.379 | 0.0124 | 0.203 | 2.72 |
| 3 | 4.4 | 70.3 | 0.0192 | 0.626 | 7.40 | 201 | 0.484 | 0.654 | 0.0163 | 0.523 | 5.71 |
| 4 | 2.5 | 26.3 | 0.0145 | 0.458 | 4.00 | 118 | 0.300 | 0.493 | 0.00773 | 0.231 | 3.28 |
| 5 | 1.4 | 15.0 | 0.0544 | 0.491 | 3.62 | 90.1 | 0.443 | 2.87 | 0.00579 | 0.308 | 7.32 |
| 6 | 0.78 | 1.83 | 0.233 | 0.145 | 1.30 | 20.5 | 0.425 | 1.53 | 0.00268 | 0.393 | 11.0 |
| 7 | 0.44 | 2.12 | 0.0782 | 0.224 | 4.26 | 9.77 | 0.589 | 1.81 | 0.00280 | 0.788 | 7.40 |
| 8 | 0.25 | -[a] | 0.0526 | 0.089 | 1.93 | 3.72 | 0.851 | 0.952 | 0.00205 | 1.32 | 3.72 |

[a] Air concentrations less than filter blank

V-7: Air concentrations (ng $m^{-3}$) of trace metals from the 1st set of summer intensive sampling (7/3/2008-7/7/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 18.6 | 0.00549 | 0.195 | 1.24 | 26.4 | 0.126 | 0.104 | 0.00377 | 0.0796 | 0.848 |
| 2 | 7.8 | 29.6 | 0.00709 | 0.285 | 4.67 | 50.4 | 0.211 | 0.200 | 0.00715 | 0.154 | 1.93 |
| 3 | 4.4 | 47.3 | 0.00877 | 0.485 | 8.29 | 79.1 | 0.305 | 0.211 | 0.0106 | 0.239 | 1.32 |
| 4 | 2.5 | 17.3 | 0.00507 | 0.151 | 7.41 | 32.2 | 0.0976 | 0.149 | 0.00232 | 0.120 | 0.861 |
| 5 | 1.4 | 28.4 | 0.0129 | 0.216 | 14.4 | 34.0 | 0.146 | 0.766 | 0.00542 | 0.259 | 1.25 |
| 6 | 0.78 | 35.0 | 0.0143 | 0.257 | 9.63 | 19.6 | 0.328 | 0.681 | 0.00409 | 0.670 | 2.53 |
| 7 | 0.44 | 12.7 | 0.0119 | 0.0581 | 3.07 | 2.64 | 0.318 | 0.348 | 0.000708 | 0.797 | 1.40 |
| 8 | 0.25 | 15.6 | 0.0121 | 0.0873 | 1.34 | 2.80 | 1.05 | 0.438 | 0.000804 | 1.86 | 3.17 |

V-8: Air concentrations (ng $m^{-3}$) of trace metals from the 2nd set of summer intensive sampling (7/7/2008-7/11/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 20.0 | 0.00413 | 0.0933 | 0.606 | 41.4 | 0.134 | 0.234 | 0.00259 | 0.0939 | 1.57 |
| 2 | 7.8 | 46.6 | 0.00675 | 0.172 | 1.09 | 67.9 | 0.148 | 0.309 | 0.0108 | 0.194 | 1.80 |
| 3 | 4.4 | 83.1 | 0.0141 | 0.370 | 3.43 | 116 | 0.496 | 0.515 | 0.0162 | 0.376 | 3.10 |
| 4 | 2.5 | 37.4 | 0.00422 | 0.152 | 1.42 | 59.1 | 0.0771 | 0.144 | 0.00809 | 0.166 | 0.790 |
| 5 | 1.4 | 17.0 | 0.0127 | 0.150 | 1.47 | 48.7 | 0.211 | 0.328 | 0.00263 | 0.243 | 3.22 |
| 6 | 0.78 | 18.8 | 0.00922 | 0.0490 | 0.504 | 9.37 | 0.166 | 0.347 | 0.000865 | 0.235 | 2.05 |
| 7 | 0.44 | 11.0 | 0.0146 | 0.0450 | 0.329 | 5.12 | 0.280 | 0.383 | 0.000581 | 0.708 | 1.65 |
| 8 | 0.25 | 8.46 | 0.0156 | 0.113 | 0.510 | 4.96 | 0.730 | 0.426 | 0.000680 | 1.64 | 1.84 |

V-9: Air concentrations (ng $m^{-3}$) of trace metals from the 3rd set of summer intensive sampling (7/11/2008-7/15/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 24.1 | 0.00417 | 0.189 | 0.909 | 41.0 | 0.0937 | 0.259 | 0.00378 | 0.110 | 1.21 |
| 2 | 7.8 | 32.7 | 0.00432 | 0.140 | 1.58 | 45.2 | 0.117 | 0.259 | 0.00447 | 0.171 | 1.34 |
| 3 | 4.4 | 24.3 | 0.00327 | 0.0742 | 1.35 | 31.4 | 0.0516 | 0.122 | 0.00320 | 0.112 | 0.648 |
| 4 | 2.5 | 14.0 | 0.00112 | 0.0409 | 1.05 | 14.4 | 0.0669 | 0.0771 | 0.00101 | 0.059 | 0.611 |
| 5 | 1.4 | 5.68 | 0.00649 | 0.0520 | 3.48 | 22.8 | 0.130 | 0.139 | 0.000911 | 0.169 | 1.25 |
| 6 | 0.78 | 3.28 | 0.00686 | 0.0324 | 2.64 | 10.2 | 0.139 | 0.255 | 0.000745 | 0.277 | 1.43 |
| 7 | 0.44 | 12.3 | 0.0180 | 0.0458 | 1.41 | 4.68 | 0.350 | 0.419 | 0.000656 | 1.01 | 1.60 |
| 8 | 0.25 | 3.38 | 0.0200 | 0.0413 | 0.470 | 2.86 | 0.774 | 0.397 | 0.000816 | 2.32 | 1.32 |

V-10: Air concentrations (ng $m^{-3}$) of trace metals from the $4^{th}$ set of summer intensive sampling (7/15/2008-7/19/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 47.1 | 0.00261 | 0.185 | 0.938 | 52.3 | 0.107 | 0.348 | 0.00989 | 0.125 | 1.49 |
| 2 | 7.8 | 89.0 | 0.00675 | 0.414 | 2.69 | 107 | 0.210 | 0.599 | 0.0208 | 0.254 | 2.72 |
| 3 | 4.4 | 67.5 | 0.00938 | 0.400 | 4.69 | 97.7 | 0.169 | 0.458 | 0.0131 | 0.231 | 2.00 |
| 4 | 2.5 | 16.3 | 0.00433 | 0.124 | 4.29 | 50.7 | 0.122 | 0.238 | 0.00234 | 0.119 | 1.19 |
| 5 | 1.4 | 11.5 | 0.0104 | 0.126 | 5.91 | 39.2 | 0.0936 | 0.288 | 0.00145 | 0.124 | 1.89 |
| 6 | 0.78 | 8.14 | 0.0188 | 0.0709 | 4.59 | 17.6 | 0.103 | 0.476 | 0.000636 | 0.197 | 1.97 |
| 7 | 0.44 | 6.30 | 0.0315 | 0.0484 | 2.04 | 7.75 | 0.324 | 0.700 | 0.000561 | 0.724 | 2.12 |
| 8 | 0.25 | 10.4 | 0.0245 | 0.102 | 1.23 | 4.70 | 0.742 | 0.606 | 0.000859 | 1.54 | 2.14 |

V-11: Air concentrations (ng $m^{-3}$) of trace metals from the 5th set of summer intensive sampling (7/19/2008-7/23/2008)

| Stage | Mid-Point (µm) | Al | Cd | Cr | Cu | Fe | Ni | Pb | Sc | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 12.9 | 0.000848 | 0.0744 | 0.321 | 21.2 | 0.0643 | 0.122 | 0.00273 | 0.0637 | 0.296 |
| 2 | 7.8 | 62.8 | 0.00582 | 0.181 | 1.22 | 66.1 | 0.170 | 0.347 | 0.0136 | 0.169 | 1.54 |
| 3 | 4.4 | 67.7 | 0.0202 | 0.280 | 1.83 | 69.4 | 0.445 | 0.357 | 0.0197 | 0.175 | 1.72 |
| 4 | 2.5 | 58.8 | 0.00971 | 0.177 | 1.95 | 61.6 | 0.156 | 0.221 | 0.0113 | 0.155 | 1.44 |
| 5 | 1.4 | 18.4 | 0.00552 | 0.0901 | 1.97 | 35.8 | 0.185 | 0.245 | 0.00301 | 0.127 | 1.64 |
| 6 | 0.78 | 6.72 | 0.00775 | 0.0271 | 0.879 | 9.19 | 0.0916 | 0.301 | 0.00104 | 0.122 | 2.15 |
| 7 | 0.44 | 2.52 | 0.0149 | 0.0198 | 0.507 | 3.88 | 0.207 | 0.347 | 0.000734 | 0.332 | 1.36 |
| 8 | 0.25 | 0.908 | 0.00729 | 0.0323 | 0.252 | 2.12 | 0.472 | 0.218 | 0.000914 | 0.461 | 1.20 |