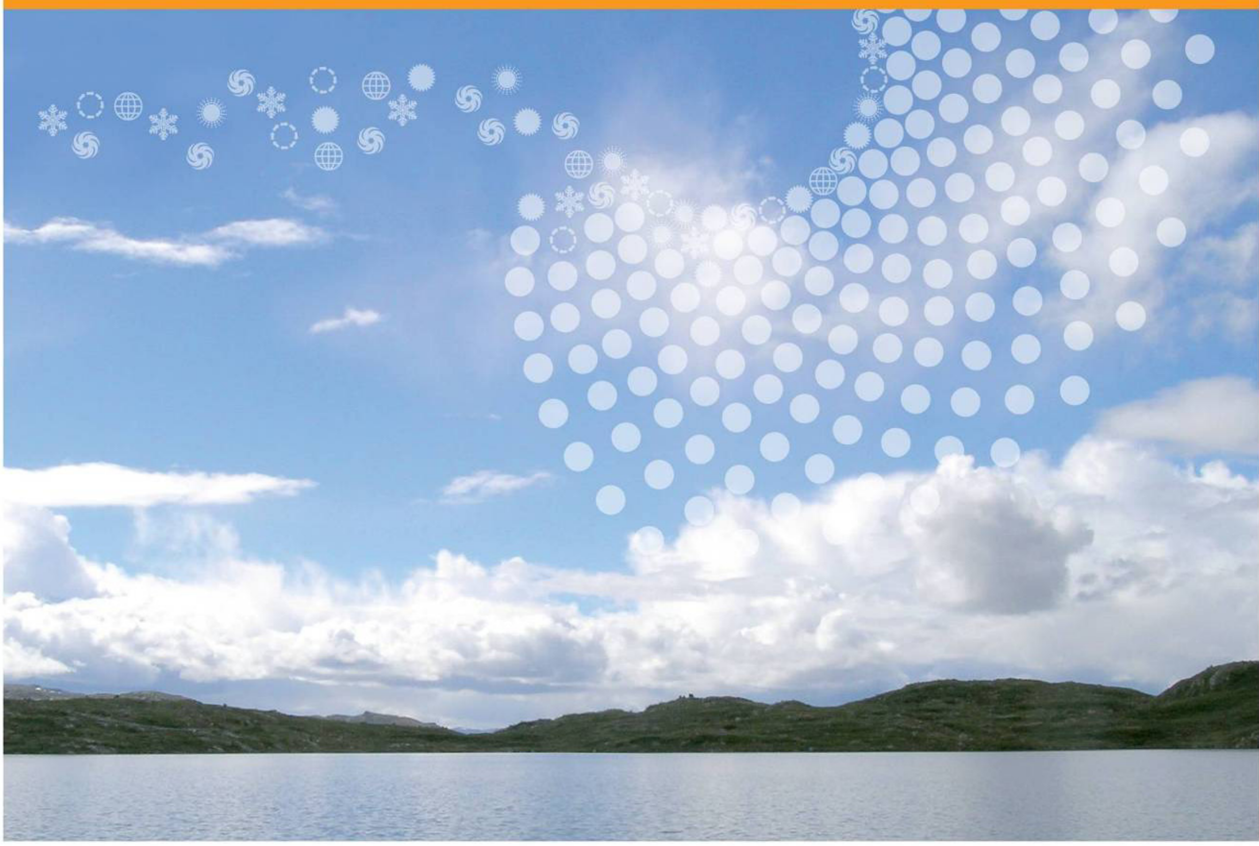
Statlig program for forurensningsovervåking

Status of metals and environmental pollutants in lakes and fish from the Norwegian part of the amap region

NATIONAL LAKE SURVEY 2004 - 2006, PART III: AMAP

2363
2008



Akvaplan niva

NIVA Norsk institutt for vannforskning

Statlig program for forurensningsovervåking:
Overvåking av langtransportert luft og nedbør

SPFO-rapport: 1013/08
TA-2363/2008
ISBN 978-82-577-5285-9

Oppdragsgiver: Statens forurensningstilsyn (SFT)
Utførende institusjon: Akvaplan-niva, Norsk institutt for vannforskning

:

National lake survey 2004 – 2006, PART III: AMAP

Rapport
1013/08

Status of metals and environmental pollutants in lakes and fish from the Norwegian part of the AMAP region

Akvaplan-niva project 3613
NIVA LNO 5550

Preface

The Norwegian Pollution Control Authority (Statens forurensningstilsyn - SFT) is today responsible for several of the national programs for monitoring of pollutants in freshwater systems. Other programs in freshwater have been run by Directorate for Nature Management (Direktoratet for naturforvaltning - DN). In 2003 SFT and DN wanted a better link between the different national monitoring programs in freshwater and therefore the SAMOVER-project was established. The intention with SAMOVER was to synchronise and harmonise the future monitoring to a greater extent by studying the same lakes in several of the programs. This would give more detailed information and better understanding of the processes in the lakes that are included in these studies. This will again lead to a better national monitoring and management of freshwater in Norway.

Reporting from this project (SAMOVER) has been published in several reports. Previous reports:

- Skjelkvåle, B.L., Christensen, G.N., Fjeld, E. Høgåsen, T., Oredalen, T.J., Rognerud, S. Schartau, A.K., 2003. Nasjonale programmer for innsjøovervåking. Samordning av lokaliteter og fremtidige utfordringer. SFT report 870/2003.
- Skjelkvåle, B.L., Christensen, G.N., Rognerud, S, Schartau, A.K., Fjeld, E., 2006. Nasjonale programmer for innsjøovervåking. Samordnet nasjonal innsjøovervåking; effekter av langtransporterte forurensninger - plan for programmet og framdriftsrapport for 2004 og 2005. SFT report 956/2006.

The following reports will be published in 2008:

- Nasjonal innsjøundersøkelse 2004-2006, DEL I: Vannkjemi. Status for forsuring, næringsalter og metaller.
- Nasjonal innsjøundersøkelse 2004-2006, DEL II: Sedimenter. Forurensning av metaller, PAH og PCB.
- National lake survey 2004-2006, PART III: AMAP. Status of metals and environmental pollutants in lakes and fish from the Norwegian part of the AMAP region.
- Samordnet nasjonal innsjøundersøkelse 2004-2006, DEL IV: Miljøgifter i fisk i 10 innsjølokaliteter på Svalbard, Bjørnøya og fastlands-Norge.

This report is part III of the “National survey 2004-2006” and contains results from investigations of pollutants in sediments and fish in the Norwegian part of the AMAP region.

Guttorm N. Christensen, Sigurd Rognerud and Brit Lisa Skjelkvåle have been responsible for the planning and carrying out fieldwork. Guttorm N. Christensen and Anita Evenset have been responsible for the reporting. Rune Palerud have produced all the maps in the report. Jon Ove Scheie, Nina Eide and Hege Selås were field assistants on Svalbard. A seaplane from Fonna Fly was used for sampling in the lakes on the mainland. The plane was safely operated by Per P. Korsvold.

All the analyses of POPs, and some analyses of PAH in sediments, were performed by Scientific Production Association ”Typhoon”, Center for Environmental Chemistry, Obninsk, Russia. Most of the PAH-analyses in sediments were performed by Unilab Analyse, Tromsø, Norway, while NIVA was responsible for analyses of heavy metals and loss on ignition (LOI).

We like to thank all the persons that have been involved in this project. A special thank to The Governor of Svalbard, Spitsbergen Travel (Hilde Fålun Strøm), Sabine Cochrane, Ivar Sørensen, Gunnar Lund, Valnesvatn grunneierlag (Odd Kåre Freding).

Finally thanks to Tor Johannessen and Ola Glesne in SFT for good cooperation.

Field work, data analysis and reporting were financed by the Norwegian Pollution Control Authority (SFT). Statoil have financed PAH investigations in 32 of the lakes along the coast in Northern Norway.

Guttorm N. Christensen   Tromsø, February 2008

Kjerrvatn (218), Nordland County (photo: G. N. Christensen).

Table of content

1. Summary

1.1 Background for the project

The Norwegian Pollution Control Authority (Statens forurensningstilsyn - SFT) is today responsible for several of the national programs for monitoring of pollutants in freshwater systems. Other programs in freshwater have been run by Directorate for Nature Management (Direktoratet for natruforvaltning - DN). In 2004 SFT and DN wanted a better link between the different national monitoring programs in freshwater and therefore the SAMOVER-project was established 2004. The intention with SAMOVER was to synchronise and harmonise the future monitoring to a greater extent by studying the same lakes in several of the programs. This would give more detailed information and better understanding of the processes in the lakes that are included in these studies. This will again lead to a better national monitoring and management of freshwater in Norway.

This report is part III of the "National survey 2004-2006" and contains results from investigations of pollutants in sediments and fish in the Norwegian part of the AMAP region.

1.2 Objectives

The main goal for this project is to give an overview of the effects of long range atmospheric transport of contaminants to lakes on the mainland of Norway and Svalbard. This has been fulfilled through the following sub goals:

- Mapping of levels of contaminants in lakes on the mainland and on Svalbard.
- Evaluation of time trends of different contaminants based this study and previous studies.

The results from the present investigation can be used to fulfil requirements for documentation of contamination status given in the Convention for Long-range Transboundary Air Pollution (convention LRTAP), as well as to add data on time trends to the AMAP database.

1.3 Study area

The AMAP region in Norway is defined as the area north of the Polar circle. In the present investigation 123 lakes were sampled, of which 115 are located on the mainland of Norway and 8 on Svalbard. Many of the selected lakes (55) were included in the previous AMAP lake survey in the mid 1990ties, but in addition 68 lakes, that are included in the ongoing national lake survey, were included. Sediment from 122 lakes were analysed for loss on ignition and metals, while PAHs and POPs were investigated in sediments from a subset of the lakes. Fish samples were collected from 8 lakes (1 in Nordland, 1 in Troms, 2 in Finnmark, 2 on Bjørnøya and 2 on Svalbard).

1.4 Main conclusions from the AMAP study

1.4.1 Metals in sediment

Generally the highest concentration of mercury (Hg) in the sediment surface layer was recorded in the lakes along the coast. In addition, elevated levels were recorded in lakes in the eastern part of Finnmark County (Sør-Varanger municipality). The median value for the 122 investigated lakes was 0.15 µg/g dw. The mean levels of Hg in the lakes on Svalbard (0.13 µg/g dw) were slightly lower than the levels on the mainland (0.16 µg/g dw). Enrichment factors for Hg indicate that most of the lakes are moderately to markedly enriched with mercury. The highest enrichment factors were observed in some of the lakes in eastern Finnmark County (severely to extremely enriched). There has been a slight increase in concentrations in recent time. The highest increase occurs along the coast and in eastern Finnmark.

The concentrations of lead (Pb) are markedly elevated along the whole coast and the highest levels were recorded along the coast of Nordland County. The median value for all the lakes that are included in this study was 57 µg/g dw. The lowest concentrations were observed in the lakes in the inner part of Finnmark County. The enrichment factor plot clearly reveals that the investigated area is generally markedly to severely enriched with Pb. The lakes on Svalbard seem to be only slightly enriched. There have been moderate changes in concentrations in recent time.

The concentrations of cadmium (Cd) are generally low in lake surface sediments from the whole region, with a median level at 0.59 µg/g dw. The plot of the enrichment factors reveals that the region in general is slightly to moderately enriched with Cd. There have only been small changes in concentrations in recent time.

The highest concentrations of antimony (Sb) in surface sediment were measured in the lakes located along the coast of Nordland County, with levels up to 0.86 µg/g dw. The median value for the whole region was 0.42 µg/g dw. The levels in the lakes on Svalbard were low (0.03 - 0.07 µg/g dw). The enrichment factor plot clearly reveals that lake sediment from lakes in Lofoten and Vesterålen in Nordland County and the eastern and inner part of Finnmark County are severely to extremely enriched with antimony. There have been no changes in concentrations in the region in recent time.

The levels of bismuth (Bi) were highest along the coast and in eastern Finnmark, with levels up to 2.07 µg/g dw. The median concentration for the lakes in this study was 0.48 µg/g dw. It is clear that Lofoten and Vesterålen in Nordland County and the eastern part of Finnmark are the most enriched areas (severely to extremely enriched). The lakes on Svalbard are only slightly to moderately enriched. There have only been small changes in Nordland and Troms County in recent time while there has been a slight increase in Finnmark.

Elevated levels of arsenic (As) in surface sediment were found in the lakes along the coast and in eastern Finnmark County. The median concentration of arsenic in surface sediment for all the lakes in this study was 8.96 µg/g dw. The lakes along the coast and in eastern Finnmark were most enriched. There have been no changes or a slight decrease in As-concentrations in lakes in Nordland and Troms Counties in recent time. In the eastern part of Finnmark County there has been a slight increase in some of the lakes.

The concentrations of tin (Sn) are generally low in the region, with a median concentration on 0.42 µg/g dw. The levels are considerably below the concentrations found in lakes in the southern part of Norway. The plot of enrichment factor reveals that many of the lakes are severely to extremely enriched with Sn. There has been a slight decrease in the levels in Nordland in recent time, while there are no changes in the rest of the study area.

Concentrations of tellurium (Te) in surface sediments were highest in the coastal areas and in the eastern part of Finnmark County. The levels in the studied area (median value 0.26 µg/g dw) are comparable to levels in the southern part of Norway (Rognerud *et al.* 2008). Lakes in Lofoten / Vesterålen in Nordland County and the eastern part of Finnmark are categorised as severely to extremely enriched with tellurium, but there have only been small changes in the levels of Te in recent time. However, a slight increase seems to have taken place in the Lofoten / Vesterålen area and in eastern Finnmark. The increase of Te in the lakes in eastern Finnmark (Jarfjord area) is related to the activity at the smelters in Nikel, Russia where they use ore that contains Te.

The highest concentrations of nickel (Ni) in surface sediments were recorded in the lakes in eastern Finnmark on the Sør-Varanger Peninsula. The concentrations in the 14 lakes in this area ranged from 61.2 - 456.1 µg/g dw, with an average concentration of 143.4 µg/g dw. The median value for all the lakes in this study was 30.3 µg/g dw. Most of the lakes can be categorised as slightly to moderately enriched with nickel, but many of the lakes in the eastern part of Finnmark County are categorised as severely to extremely enriched. There has also recently been a severe increase in the concentrations of nickel in sediments in the eastern part of Finnmark. The reason for this is increased emissions of Ni from the smelters in Nikel, Russia.

The concentrations of copper (Cu) in surface sediment were below 70 µg/g dw in the major part of the region. The median level for all the lakes in this study was 46.2 µg/g dw. Almost all the lakes in the region are categorised as slightly enriched with copper, except some of the lakes in eastern Finnmark which are categorised as markedly to extremely enriched. The higher levels measured in the eastern part of Finnmark are caused by emissions from the smelter industry in Nikel, Russia. There have been small changes in the Cu concentrations during the last decades, except in the lakes in eastern Finnmark where the concentrations have increased.

The highest levels of selenium (Se) in surface sediment were recorded in lakes along the coast and in eastern Finnmark. The median level in surface sediment for the whole area was 3.6 µg/g dw. Most of the lakes in this study are sligthly to moderately enriched with selenium. During recent years there has been a slight increase in concentrations in the coastal areas in Finnmark.

The concentrations of cobalt (Co) in surface sediments were highest along the coast and in eastern Finnmark. The median levels for all the investigated lakes were 23.3 µg/g dw. The whole study area was slightly to moderately enriched with cobalt except for some of the lakes in eastern Finnmark that was markedly to extremely enriched. There have been small changes in the concentrations in most of the region during the last few decades. However, the levels of cobalt have increased in lake sediments in eastern Finnmark. The reason for the high levels, higher enrichment factor and the increasing levels of cobalt in eastern Finnmark are increased emissions from the smelter industry in Nikel, Russia.

The concentrations of thallium (Tl) in surface sediment were generally higher along the coast compared to the lakes in the inland, due to higher content of thallium in the bedrock along the coast. The median value of thallium in surface sediment in the region is 0.43 µg/g dw. The lake sediments in Northern Norway are only slightly to moderately enriched with thallium. There have only been small changes over the last few decades.

The concentrations of silver (Ag) in surface sediment were generally low in the whole region and the levels in surface sediment were comparable to the levels in the reference layer. Therefore almost all of the lakes are categorised as slightly to moderately enriched with Ag. In recent years there has been a slight increase in Ag-concentrations in the lakes located in Finnmark County.

The level of the metals vanadium (V), chromium (Cr) and zinc (Zn) were relatively high compared to the levels of many of the other metals, but this was due to the natural geochemical conditions in the region (high concentrations in the bedrock). The levels of molybdenum (Mo) and wolfram (W) were also were comparable to the levels in the in the bedrock. The degree of enrichment for V, Cr, Zn, Mo and W was low (categorised as not or slightly enriched). There have been only small changes in the levels of these metals (V, Cr, Zn, Mo and W) in the sediment during the last decades.

1.4.2 PAH and POPs in sediments

The PAH concentrations in surface sediments ranged from 17.6 ng/g dw (Lake Cearpmatjavri in Nordland) to 6 615 ng/g dw (Lake Trolldalsvatn in Nordland). Generally the highest PAH-levels were found in Nordland (average sum PAH-concentration 2 301 ng/g dw), followed by Troms (average sum PAH-concentration 450 ng/g dw), Finnmark (average sum PAH-concentration 469 ng/g dw) and Svalbard (average sum PAH-concentration 60 ng/g dw). The PAH-levels measured in the present investigation were comparable or slightly lower than those measured in the previous AMAP lake survey (Skotvold *et al.* 1997).

The levels of PCBs were generally low in the surface sediment samples, with a few notable exceptions. The lowest levels were measured in lakes from Troms (average $\sum PCB_7 = 1.21$ ng/g dw, n = 7), followed by Finnmark (average $\sum PCB_7 = 2.08$ ng/g dw, n = 24) and Nordland (average $\sum PCB_7 = 2.79$ ng/g dw, n = 18). The highest PCB-levels in the investigation were measured in surface sediments from lakes on Svalbard (average $\sum PCB_7 = 10.16$ ng/g dw, n = 5). The PCB-levels measured in the present investigation seemed to be slightly lower than those measured in the previous AMAP lake survey.

The levels of chlorinated pesticides (HCB, DDT, HCHs, chlordane, toxaphene, endrin, dieldrin and mirex) were generally low in the sediment samples from the AMAP area. However, most of the chlorinated compounds occurred in higher concentrations in sediment from lakes on Svalbard than in sediment from lakes in Northern Norway.

The ∑PBDE-concentration varied from 25.5 ng/kg dw (Kongressvatn, Svalbard) to 9 625 ng/kg dw (Lavvojavri, Finnmark). Generally PBDE-levels were low in sediment from the lakes in Nordland (average 84 ng/kg dw), higher in lakes from Troms (average 96 ng/g dw) and highest in lakes from Svalbard and Finnmark (average 817 and 881 ng/kg dw, respectively). The levels in some of the lakes, especially in Finnmark (up to 9 625 ng/kg dw) are in the same range or higher than what has been measured in lakes localised in much more industrialised areas (e.g. the Great Lakes).

Dioxins and furans were only analysed in sediment from 12 of the lakes. The levels ranged from 1.0 ng TEQ/kg dw to 33.5 ng TEQ/kg dw. The highest concentration was found in sediment from Valnesvatn in Nordland and the lowest in Ravdojavri, located on Finnmarksvidda. Dioxin-values above levels that are usually associated with only long-range transport were measured in 6 of the 12 lakes that were investigated for dioxins.

1.4.3 Contaminants in fish

Pooled fish samples, consisting of from 7 to 12 fish each, from 8 lakes were analysed for metals and selected POPs. In addition to the pooled samples 5 individual fish from Richardvatn and Åsøvatn on Svalbard were analysed for POPs.

Generally the metal concentrations were low in fish samples from all lakes. The levels measured in the present investigation are comparable to metal levels that have been measured in fish samples previously collected in Northern- Norway, Sweden and Finland.

PAH-levels were below the analytical detection limit in most of the fish samples. Low levels of naphthalenes were measured in fish from three lakes, while a low concentration of phenanthrene was measured in fish from Lake Øyangen on Bjørnøya.

The levels of PCB in fish showed considerable variation between the investigated lakes. Low concentrations of PCBs were measured in fish from Valnesvatn, Holmvatn, Langvatn and Gavdnajavri ($\sum PCB_7$ from 123 – 895 ng/g lw). In fish from the 4 Svalbard lakes the PCB-concentrations were significantly higher, with the highest concentration measured in Arctic char from Lake Ellasjøen on Bjørnøya ($\sum PCB_7$ = 6 941 ng/g ww).

The levels of chlorinated pesticides were low in fish from lakes in Northern Norway, but the levels were generally higher in fish from the Svalbard lakes. It should be noted that fish from the two lakes on the northern edge of Svalbard, Åsøvatn and Richardvatn, had relatively high levels of chlordanes (8.33 ng/g ww or 281 ng/g lw and 15.7 ng/g ww or 982 ng/g lw, respectively).

The PBDE-levels ranged from 8.1 - 113 ng/g lw. The highest level was found in fish from Ellasjøen on Bjørnøya. However, the PBDE-level in fish from Ellasjøen was significantly lower than those reported by Evenset *et al.* (2005) for fish collected in the same lake in 1999.

Low levels of PCDDs/PCDFs were measured in all the analysed fish samples. All the samples had dioxin-concentrations that were well below the levels set for human consumption (4 ng TEQ/kg ww) by the EU (EU Commission Regulation 2001).

Five relatively large Arctic chars from Richardvatn and Åsøvatn on Svalbard were analysed for PCBs, chlorinated pesticides, PBDEs and Hg. Generally the levels of POPs were high in these individuals. However, the Hg-levels were low in these fish.

2. Introduction

The Arctic Monitoring and Assessment programme (AMAP) was established in 1991 as a part of the Arctic Environmental Protection strategy (AEPS) at the first Arctic Ministerial Conference in Rovaniemi, Finland. It was requested by Ministers of the eight Arctic countries to: "*provide reliable and sufficient information on the status of, and threats to, the Arctic environment, and to provide scientific advice on actions to be taken in order to support Arctic governments in their efforts to take remedial and preventive actions relating to contaminants.*"

The primary function of AMAP is to advise the governments of the eight Arctic countries (Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden and the United States) on matters relating to threats to the Arctic region from pollution, and associated issues. The main task of AMAP is the continuous monitoring of the levels of anthropogenic pollutants in all components of the Arctic environment including humans, and to assess the effects of these on the ecosystem.

AMAP is responsible for: "*measuring the levels, and assessing the effects of anthropogenic pollutants in all compartments of the Arctic environment, including humans; documenting trends of pollution; documenting sources and pathways of pollutants; examining the impact of pollution on Arctic flora and fauna, especially those used by indigenous people; reporting on the state of the Arctic environment; and giving advice to Ministers on priority actions needed to improve the Arctic condition.*"

The Arctic Monitoring and Assessment Programme is one of five working groups of the Arctic Council. The programme is divided in five sub-programmes; atmosphere, terrestrial, freshwater, marine and human health.

According to the AMAP sub-programme for freshwater, the elements to be studied in the monitoring of pollution in remote areas are lake sediments and fish. AMAP's priorities the following contaminant groups: Persistent organic pollutants (POPs) and heavy metals (in particular mercury, cadmium, and lead).

The AMAP region in Norway is defined as the area north of the Polar circle. Many of the selected lakes (55) were included in the previous AMAP lake survey in the mid 1990ties, but in addition 68 lakes, that are included in the ongoing national lake survey, were included. In the present investigation 123 lakes were sampled, of which 115 are located on the mainland of Norway and 8 on Svalbard. Sediment from 122 lakes were analysed for loss on ignition and metals, while PAHs and POPs were investigated in sediments from a subset of the lakes. Fish samples were collected from 8 lakes (1 in Nordland, 1 in Troms, 2 in Finnmark, 2 on Bjørnøya and 2 on Svalbard).

The emphasis of this report is on presenting levels and geographical distributions of contamination levels and trends of selected contaminants in sediment and fish from Northern Norway and Svalbard. The main focus will be on long-range transported contaminants, as most of the investigated lakes are located in areas with no or few local sources. The results from the present investigation can be used to fulfil requirements for documentation of contamination status given in the Convention for Long-range Transboundary Air Pollution (convention LRTAP), as well as to add data on time trends to the AMAP database.

3. Long-range transport of contaminants

Anthropogenic chemicals, like persistent organic pollutants (POPs) and heavy metals, are detected in the environment, even in areas far from any known point-sources, such as the Arctic. In general, the high levels of POPs and some metals that are found in Arctic areas cannot be related to known use and/or release from local sources within the Arctic and can therefore only be explained by long-range transport from lower latitudes (de March *et al.* 1998; Macdonald *et al.* 2000). For lakes transport through air currents is the only relevant transport pathway, and it has been documented that air currents/wind is an important transport pathway both for POPs and metals. POPs, PAHs and heavy metals are known to be transported from temperate latitudes either in the vapour phase or on aerosols. Today, it is widely accepted that contaminants generally reach remote freshwater systems by long distance atmospheric transport (Gregor & Gummer 1989; Barrie *et al.* 1992; Steinnes *et al.* 1994, Mackay & Wania 1995; Oehme *et al.* 1995). This transport pathway is fairly rapid (days to a year), since air masses can travel over large distances in short time (Gregor *et al.* 1998).

3.1 Metals

Many studies have shown that the Arctic is a major receptor of metals generated in other regions of the Northern Hemisphere (Dietz *et al.* 1998; AMAP 2005). In general, metal concentrations in Arctic lakes have increased since the onset of the industrial revolution (Dietz *et al.*, 1998), but different trends have been reported for different metals, depending on usage pattern, discharges, transport pathway and metal properties (i.e. sediment affinities). Most information is available for lead (Pb), cadmium (Cd) and mercury (Hg), due to concerns for their high toxicity, relatively high volatility and large volume discharges to the atmosphere from industrial processes (Barrie *et al.* 1992). These are also the heavy metals that are highly prioritised in AMAP.

Lead (Pb) is one of the heavy metal elements which are shown to be transported to the Arctic and are now widespread within Arctic areas. Several studies in Arctic areas have concluded that Pb-concentrations increased after the introduction of leaded gasoline on the northern hemisphere. After the phasing out of leaded gasoline, Pb-concentrations have been declining (AMAP 2005).

Earlier investigations have not revealed any large atmospheric point sources for Pb in Norway (Rühling *et al.* 1987). The large smelters at the Kola Peninsula may contribute somewhat, but earlier studies have documented that Pb is not a major component of the smelter emissions in the Kola region (Pacyna *et al.* 1993; Dauvalter 1994). Surveys of heavy metals in mosses and lake sediments conclude that the main sources of deposited lead in Norway are long range transport (Steinnes *et al.* 1994; Rühling & Steinnes 1998).

Also depositions of cadmium (Cd) in the Arctic are mainly due to long-range atmospheric transport, but local emissions from smelter industry and waste incineration of nickel-cadmium batteries contribute. In the 1996-1997 Norwegian national lake sediment survey Rognerud & Fjeld (2001) and Skotvold *et al.* 1997 found a slight enrichment of Cd in lakes in Northern Norway and they attributed this to long-range transport. In a study of sediment cores from lakes in the boarder area between Norway and Russia a concentric pattern of enrichment of Cd was found around the Murmansk smelters (Dauvalter 1994; Dauvalter & Rognerud 2002). However as a general trend, industrial Cd sources do not appear to have resulted in increasing levels of Cd in most areas of the Arctic, although regions close to industrial areas have been affected (AMAP 2005).

Long distance atmospheric transport is suggested as being the primary source of mercury (Hg) to remote areas. Hg is mainly transported in gaseous form, and recent studies have shown that Hg that reaches Arctic regions is removed from the atmosphere and deposited on snow in a form that can become bioavaliable. Enhanced deposition in the Arctic region has been linked to processes that occur during the polar sunrise. The processes are probably being catalysed by bromine (Br), which is released from seawater. The deposition of Hg is therefore larger close to the sea than in inland areas (MacDonald *et al.* 2003). Investigations in Norway have shown a high degree of Hg contamination in lakes in southern regions. A few lakes in Sør-Varanger municipality and in the Pasvik watercourse, in the easternmost part of Northern Norway, have shown moderate Hg contamination (Rognerud & Fjeld 1993, Christensen *et al.* 2007a).

Depositions of nickel (Ni) and copper (Cu) in northern Norway are generally of local origin (Rognerud and Fjeld 2001; Steinnes *et al.* 2005), since the large Cu- and Ni-smelters in Nikel and Zapolyarny in Northwest Russia are major sources for these metals (Wright and Traaen, 1992). Studies in the Pasvik watercourse (Norwegian-Russian border) reveal high levels of Ni in both sediments and fish (Christensen *et al.* 2007a and b, Amundsen *et al.* 2006). In a recent study from Bjørnøya Evenset *et al.* (2007a) indicated that lake sediment in lake Ellasjøen had been affected by emissions from the Russian smelters, since trends in the concentrations of Ni seemed to follow the trends in the discharges from the smelters.

The deposition of the metals antimony (Sb) and arsenic (As) in Norway mainly occurs by means of long range atmospheric transport. Depositions from local emissions of both Sb and As are found in the County of Nordland. The Russian smelters contribute to depositions of As in the eastern parts of the Finnmark County (Steinnes *et al.* 1994).

Few data are available in Norway concerning the sources and deposition of the element titanium (Ti). The depositions of zinc (Zn) in northern parts of Norway are mainly caused by long range atmospheric transport (Steinnes *et al.* 1994).

There is no evidence of depositions of iron (Fe) and aluminium (Al) due to long range transport. Studies of mosses show that elevated concentrations of these elements in specific areas can be explained by contributions from local soil materials (windblown dust) or release from soil due to acidification (Steinnes *et al.* 1994). In Nordland, local Fe and Al deposition occurs due to smelter activity. In Sør-Varanger (East-Finnmark) mining activities contribute to some of the depositions (Steinnes *et al.* 1994).

3.2 POPs

Persistent organic pollutants (POPs) are man-made, carbon containing chemical compounds that, to a varying degree, resist photochemical, biological and chemical degradation. POPs are often halogenated and characterize by low water solubility and high lipid solubility. They are also semi-volatile, a property which permits these compounds either to vaporize or to be adsorbed on atmospheric particles. They therefore undergo long range transport in air and water. When the air masses reach areas with low temperatures the POPs condenses out ("cold condensation theory") and are deposited on the ground or in water bodies (Wania & Mackay 1995). This process (evaporation and condensation) can be repeated several times, a process which has been called "grass-hopping". Precipitation scavenges particles and contaminants from the atmosphere and deposits them on the earth's surface. Generally, there is a good correlation between the amount of precipitation and the deposition of contaminants. Once in the polar region, the low temperatures tend to reduce, but not preclude, volatilization and degradation, thus increasing the probability for contaminants to remain in the region (de March *et al.* 1998).

Many studies have documented the presence of relatively high levels of a number of conventional POPs (e.g. hexachloro-cyclohexanes (HCHs), polychlorinated biphenyls (PCBs), hexachlorbenzene (HCB) and cyclodiene pesticides) in the Arctic environment (see overviews in AMAP 2004; Macdonald *et al.* 2000). In recent years, also studies of newer halogenated contaminants, e.g. brominated flame retardants and fluorinated compounds, have proved the presence of these current-used chemicals in the Arctic environment (Jansson *et al.* 1987; 1993; Alaee *et al.* 1999; Herzke *et al.* 2003; AMAP 2004; Verreault *et al.* 2004; Evenset *et al.* 2007a).

Many POPs have had and still have wide applications in agricultural areas outside the Arctic region, where they have been or still are used for pesticide control and fighting of insect-borne diseases (e.g. DDT, toxaphene, technical HCH, chlordanes, endrin, dieldrin, and mirex). Other POPs, like PCBs, have been more extensively used in industrial and urban areas of the world in e.g. electric equipment, heat exchange fluids, paints etc. Many of the POPs that are found in high levels in the Arctic environment have now been banned or restricted by most western countries (e.g. PCB, DDT[1], HCB, chlordanes, toxaphene) and others have more or less voluntary been phased out. The current levels of these compounds in the environment are therefore mostly considered as a legacy of past emissions, and given enough time, their levels are expected to decline. However, many of these compounds can still be found in old equipment and installations, and leakage from old waste dumps and land fills is a continuous source for these contaminants to the environment. Also contaminated soil in industrial or agricultural areas is a continuous source for POPs. Due to the persistency of POPs in the environment these sources will be active for years to come.

However, not all POPs found in the Arctic can be attributed to old sins. A number of POPs identified in the Arctic environment are still produced and applied in large quantities. One of these compound groups is the brominated flame retardants (BFRs). BFRs are today widely used in e.g. electronic equipment, insulation material and furniture (de Wit 2002). After use, substances like BFRs reach the environment through wastewater, sludge, and landfills, and since they are still used the sources are obviously numerous.

Polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) are often described with a generic term as dioxins. Dioxins are a class of chemical contaminants that are formed as by-products during combustion processes such as waste incineration, forest fires, and backyard trash burning, as well as during some industrial processes such as paper pulp bleaching and herbicide manufacturing. The most toxic chemical in the class is 2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD). The highest environmental concentrations of dioxin are usually found in soil and sediment, with much lower levels found in air and water. Dioxin accumulates in the fatty tissues, where they may persist for months or years. In Northern Norway there are a few industrial companies that release dioxin to the environment but the emissions have decreased the last 20 years.

---

[1] DDT is still produced in China and India, and used for fighting of malaria and other insect-borne diseases in more than 25 countries (AMAP 2004).

4. Factors determining the environmental state in lakes

There are several factors and processes that can determine the contaminant concentration in lakes. Some of these, like natural background concentration, are mainly relevant for metals, while other (e.g. vegetation and soil in catchment area, topography of catchment area, meteorological conditions) are important for all contaminants. In the following chapters some of the processes determining contaminant concentrations in lakes are briefly discussed.

4.1 Background levels

4.1.1 Natural background values of heavy metals

Metals are natural elements that are present in bedrock and soil. Therefore the concentrations of heavy metals in lake sediments are largely related to the natural geochemical composition of rock and soil in the catchment area. In order to assess if lake sediments have been enriched with metals as a result of anthropogenic activities the metal concentrations in recently deposited sediments must be compared with concentrations in reference sediments. Reference sediments must be deposited before the industrial revolution, when discharges from anthropogenic activities started to accelerate. There are indications that some emissions of heavy metals occurred before the industrial revolution, but to a much lesser scale than later emissions. The Greco-Romans started 3000 years ago to exploit Pb and the production was highest 2000 years ago (Renberg *et al.* 1994). Also European mining activities (top production around year 1200) have contributed to atmospheric lead emissions before the industrial revolution (Brännwall *et al.* 2001).

4.1.2 Background concentrations of POPs

Most persistent organic pollutants did not exist in the biosphere prior to their industrial synthesis, which began about 50-70 years ago. Thus industrially produced organochlorine compounds, such as PCBs and chlorinated pesticides (HCHs, chlordanes, DDTs, etc.) have no natural background concentrations. However, some organohalogens do have natural sources. Terrestrial ecosystems mainly produce chlorinated organic compounds, while brominated organic substances are dominant in the aquatic environment. Algae, as well as bacteria and fungi, produce compounds such as halogenated hydrocarbons, phenols, ketones, terpenes and C_{15} compounds (Kvernheim *et al.* 1992). Polycyclic aromatic hydrocarbons (PAHs) are mainly formed by incomplete combustion of fossil fuels and wood, as well as by processes such as incineration of garbage, steel and coal production and gasification. However, some PAHs can be formed naturally from transformation of organic material by micro-organisms. One PAH with high natural background levels is perylene, which can be formed during breakdown of humus materials. Therefore, in this investigation on contamination levels, perylene is excluded from the calculated sum PAH.

4.2 Transport from catchment area

Heavy metals may enter lakes by direct deposition on the water surface, as well as by runoff/drainage from the catchment area. Lake sediments may comprise depositions from natural sources in the catchment area, as well as atmospheric depositions on both the lake surface and the catchment area. The part which is incorporated into lake sediments depends on the characteristics of both the metals and the catchment area.

Atmospheric depositions of most persistent organic pollutants as well as lead, mercury, copper, and antimony are strongly associated with humus substances, and adsorb readily to humus soil particles. The extent and the thickness of the humus layer in the catchment area determine the capacity of the catchment area to retain these substances. The vegetation varies a lot between the different regions that were involved in the present study. Generally, the investigated lakes in Nordland County had the highest fraction of forested areas in the catchment area (average 41%). In Finnmark County, the forest area reached an average of 26%. The lowest percentage of forest was registered in Troms County (13%) (Skotvold *et al.* 1997). The cover of bogs and mires in the lake catchment areas had a complete opposite pattern compared to forested areas. In Troms County the bog and mire areas covered in average 13% of the catchment areas in 1997. In Finnmark and Nordland Counties the areas covered of bogs and mires were respectively 7.5 and 6.3% (Skotvold *et al.* 1997). The vegetation in the catchment areas of the different lakes was not investigated in the present study but we expect it to be very much the same as the situation in 1997, when this was studied by Skotvold *et al.* (1997).

The transport of heavy metals from the catchment area to a lake usually follows one of two different patterns (Bergkvist *et al.* 1989).

- Transport related to organic acids, mainly humic acids. Acidification and release of minerals in the catchment area have little effect for these compounds. In our investigation, this transport mechanism is relevant for Pb, Hg, Cu, and Sb.
- Transport related to acidification and the subsequent release of the mineral fraction of the catchment area. This transport mechanism may be of relevance for the heavy metals Cd, Ni, Al, and Zn in the eastern part of Finnmark County (Sør-Varanger), which receives contamination from the smelter industry in Russia close to the Norwegian border in Eastern Finnmark County.

4.3 Processes in lakes

Both persistent organic pollutants and heavy metals exist in particulate, colloidal and dissolved phases in lake water. The majority of pollutants are adsorbed to particles (Barrie *et al.* 1992) which, in their turn, accumulate in lakes through sedimentation processes.

It has been demonstrated that persistent organic pollutants and heavy metals differ in their mobility and transformation capacities (chemical and biological) in sediment (Hart 1982; Carigan & Tessier 1985; Andersson & Borg 1988; Barrie *et al.* 1992). This implies that concentrations of a specific substance at a specific sediment depth are not necessarily directly related to depositions during certain time-periods. The mobility varies with the physical and chemical characteristics of the specific compound, as well as with the physical, chemical and biological processes in the lake water and sediments. These effects should be evaluated for each specific element or compound.

Sedimentation rate varies between different lakes due to differences in soil and vegetation in the catchment area. In lakes with high input of organic material the sedimentation rate is high, whereas it is low in lakes with low organic input. In Arctic lakes the organic input is usually low and therefore the sedimentation rate will also be low.

5. Material and methods

The study is carried out according to the AMAP recommendations for field sampling, sample treatment and analysis. The samples from Svalbard were collected in July - August 2004 by using a small rubber boat. The plan was to collect samples from lakes on the mainland of Norway during autumn 2005, using a small seaplane. However, due to bad weather conditions most of the sampling had to be postponed to July - August 2006.

5.1 Study sites

The AMAP region in Norway is defined as the area north of the Polar circle. Most of the lakes investigated in the present survey are located north of the Polar circle, but in addition some lakes in the Nordland County south of the Polar Circle were included (*Figure 1*). Many of the selected lakes (55) were included in the previous AMAP lake survey in the mid 1990ies, but in addition 68 lakes, that are included in the ongoing national lake survey, were included. In the previous AMAP lake survey 98 lakes were included. Of these lakes 88 are located on the mainland of Norway and 10 on Svalbard and Bjørnøya (Bear Island). In the present investigation we have samples from 123 lakes, of which 115 are located on the mainland of Norway and 8 on Svalbard and Bjørnøya. Sediment from 122 lakes were analysed for loss on ignition (LOI) and metals, while PAHs and POPs were investigated in sediments from a subset of the lakes (*Figure 2*, *Figure 3* and *Figure 4*). A list of the lakes, including data on geographic position, size and depths, is given in Appendix 1.

Fish samples were collected from 8 lakes (1 in Nordland, 1 in Troms, 2 in Finnmark, 2 on Bjørnøya and 2 on Svalbard) (*Figure 1*).

Valnesvatn (210), Nordland County (photo: G. N. Christensen).

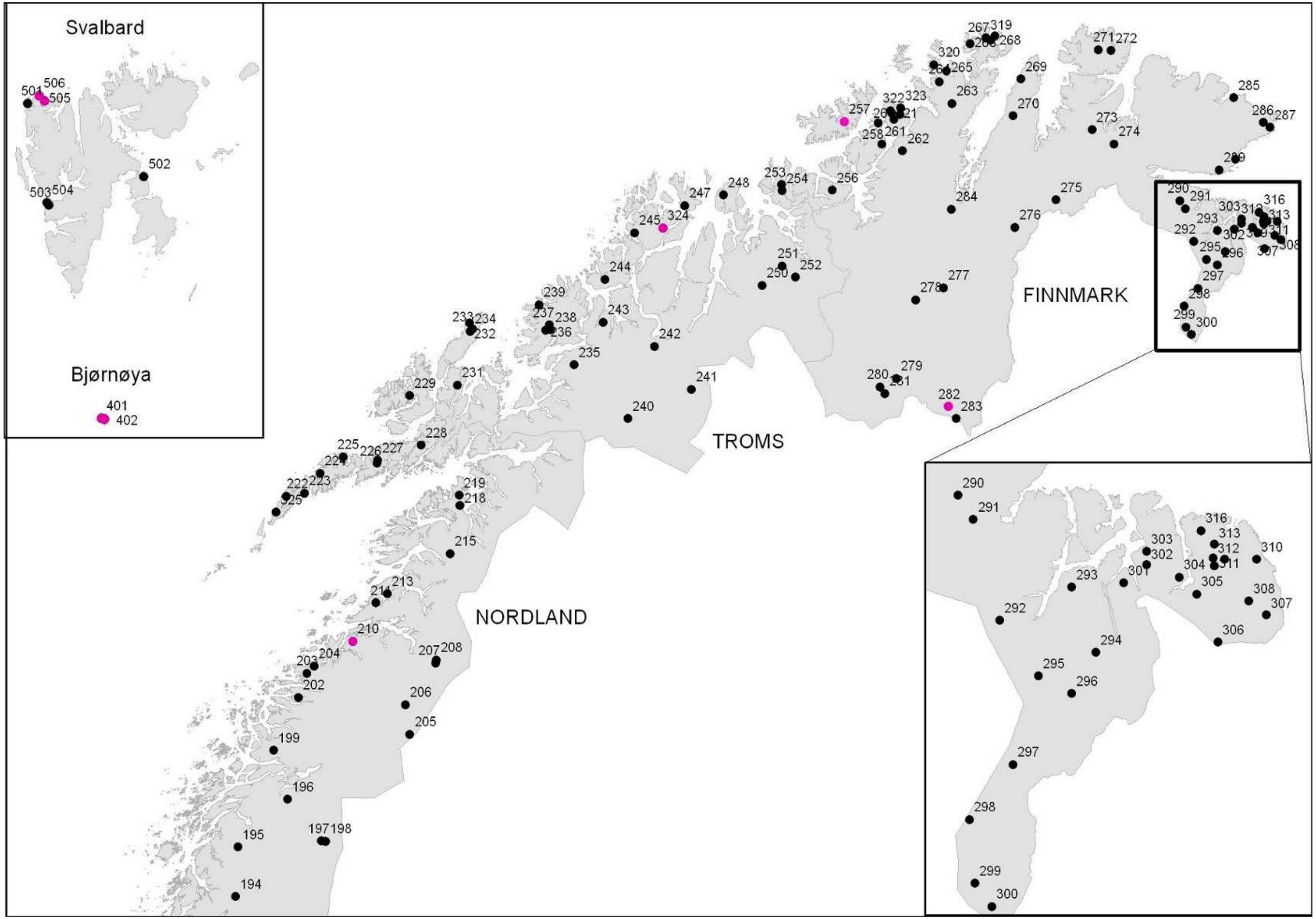


Figure 1. *Lakes included in the sediment survey (n=122) for heavy metals. Red dots indicates lakes where also samples of fish were collected (n=8). Only fish was studied in Lake Øyangen (402) on Bjørnøya, Svalbard.*

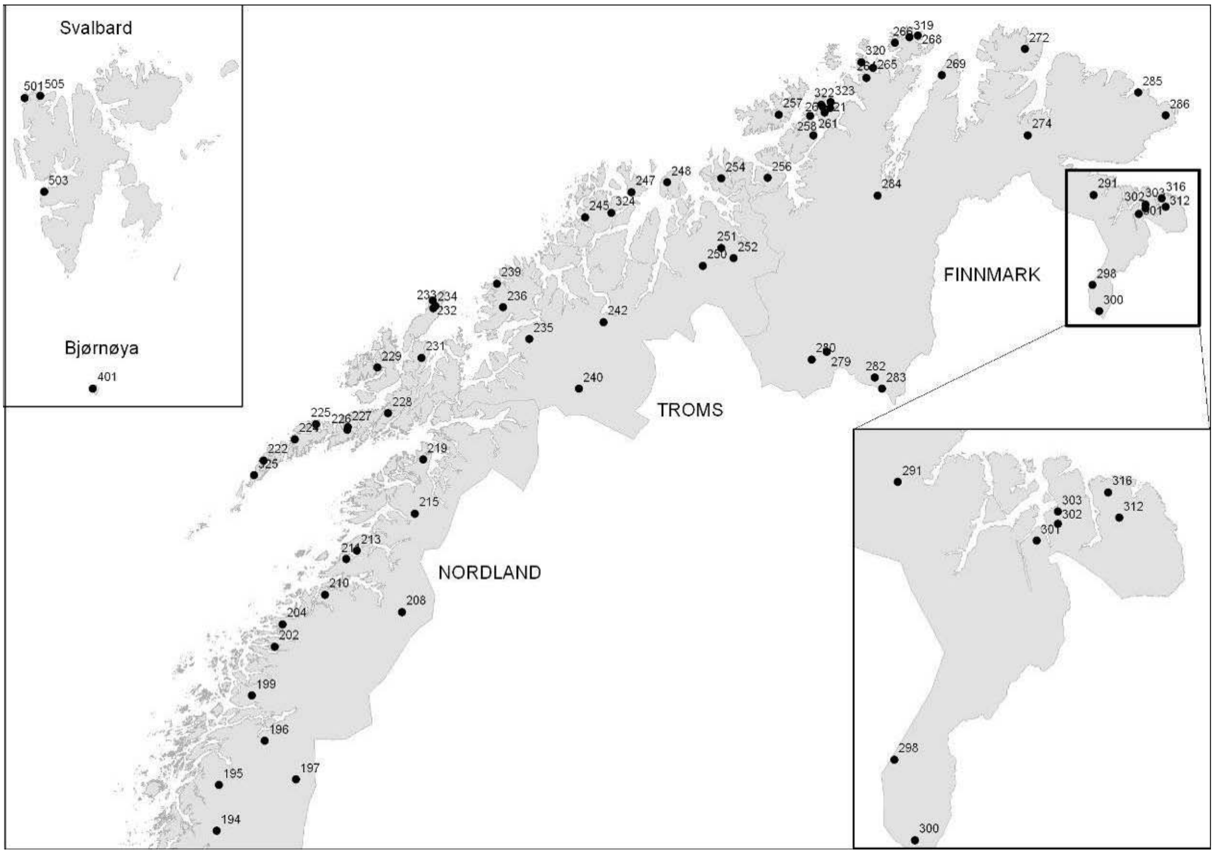


Figure 2. Lakes where surface sediment samples for PAH analysis were collected (n=75).

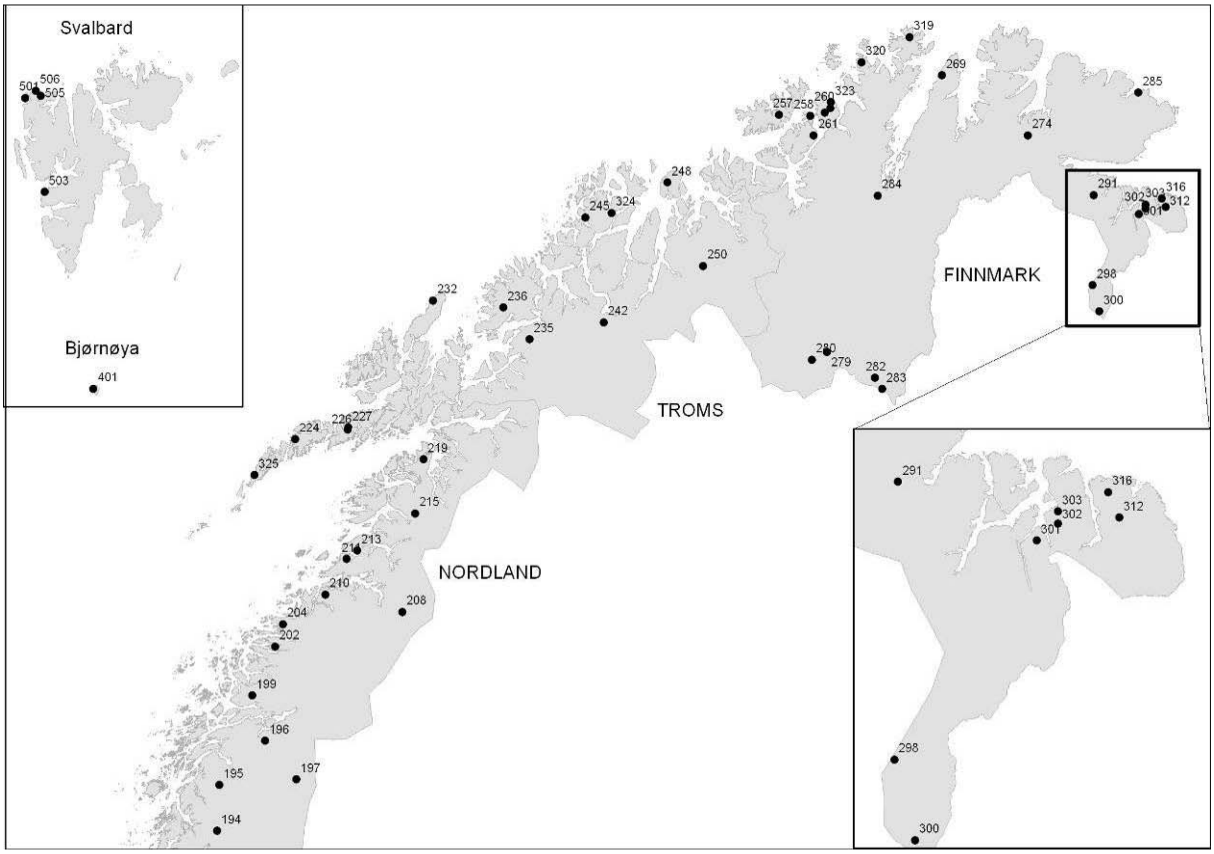


Figure 3. Lakes where surface sediment samples for PCB analysis were collected (n=54).

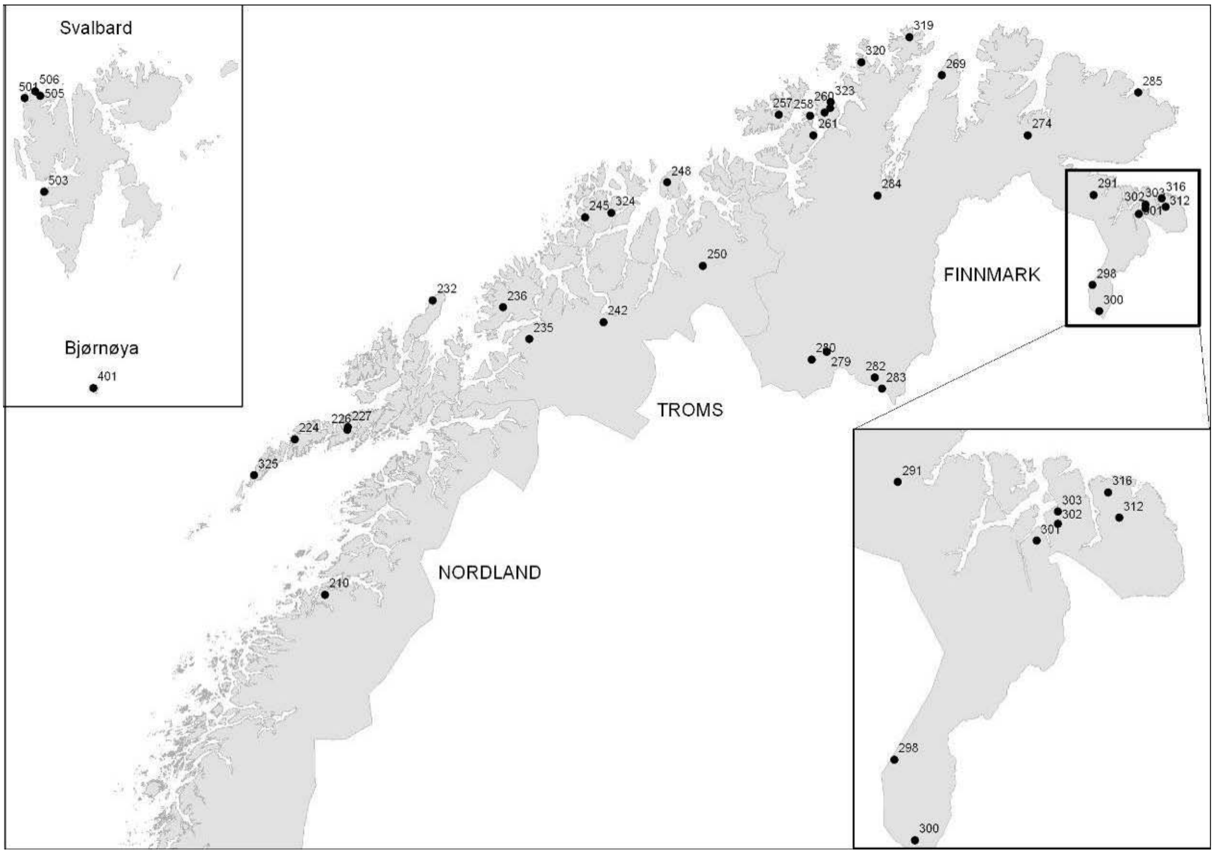


Figure 4. *Lakes where surface sediment samples for pesticides, PBDEs and dioxins analysis were collected (n=42).*

5.2 Sediment sampling

5.2.1 Sample collection and treatment

Sediment samples were collected from 122 lakes, using a modified Kajak-Brinkhurst (KB) gravity corer (75 cm long core acrylic tube with inner diameter of 80 mm) (Mudroch & Azcue 1995). On the mainland in Norway a seaplane (Cessna U/TU206) was used for the sediment sampling for almost all of the lakes. Some of the lakes on the mainland and all the lakes on Svalbard were sampled from a small rubber boat (Zodiac).

The sediment cores were sampled from the deepest part of the lake. The core sites were located using an echo-sounder that was either mounted on one of the pontoons of the seaplane or to the rail of the boat. In the seaplane a winch with a metal wire was used for lowering and lifting the corer. One person was standing on one of the pontoons to secure that the corer was lowered vertical in such a way that it carefully penetrated vertically into the sediment. The corer was then slowly winched to the surface and a plug was inserted in both ends of the tube. In the boat the corer was operated with a braided rope. The tube was then mounted in a rack. Only cores with undisturbed sediment surface layer were used.

The number of cores from each lake depended on the analysis program for the lake. One core was taken for metals, one core for PAH and two cores for POPs. Material for analyzing loss on ignition (LOI) was taken from respectively the metal core and POPs core.

The cores were sliced in different sections depending on what kind of compound they were going to be analysed for. For metal analysis the core was sliced from 0-0.5 cm (surface layer), 0.5 - 1.0 cm (subsurface layer) and a reference slice (2.0 cm) from the deepest part of the core

(35 cm ± 15 cm). The samples for metal analysis were put in plastic jars and stored in a cooler until analysed. Only the surface layer (0 - 1.0 cm) was sampled for PAH and POPs analysis. The sediment for POP analysis was transferred to pre-cleaned glass-jars and frozen to -20° C after sampling and kept frozen until analysis.

5.3 Sediment age

The time period the different sampled sections represent are dependent on the sedimentation rate in the lake and will therefore vary between the different lakes. The sediment core for metal analysis was split in 0.5 cm sections while the core for PAH and POPs analysis was split into 1.0 cm sections. The reference sediments that were used in the present investigation were collected 35±15 cm down in the sediment. The sedimentation rate is relatively low in most lakes in Northern Norway. In a recent study by Larsen *et al*. (in press) cores from 9 lakes from Nordland, Troms and Finnmark Counties were dated and the sedimentation rate was around 0.5 ±0.3 mm/year. These results are very similar to what Rognerud & Fjeld (2001) found in other lakes in Northern Norway. Based on the result from the dated cores the surface sediments (0 - 0.5 cm) represents the latest 10 to 15 years while the subsurface section (0.5 to 1.0 cm) represent the concentrations 10 - 30 years ago. The age of the reference sediments are thus more than 250 years, meaning that they were deposited in pre-industrial times.

Sediment sampling from the seaplane (photo: G. N. Christensen).

5.4 Fish sampling

5.4.1 Sample collection and treatment

Fish were sampled with gillnets. The total number of fish from each lake varied between 10 and 50. All fish were measured (fork length) to nearest millimetre and weighed on an electronic scale to the nearest gram. Sex was determined. For the analysis of POPs and the determination of lipid content, 20 grams of muscle tissue was taken from the dorsal axial muscle. All samples for POP-analyses were preserved in pre-cleaned glass-jars or pre-cleaned aluminium foil and kept frozen at -20°C until chemical analyses. From all the lakes a pooled sample was made in the laboratory by taking 10 grams of muscle from each individual fish. The pooled samples consist of 7 to 12 fish (*Table 1*). From Lake Richardvatn and Lake Åsøvatn on Svalbard also 5 individual fish were analysed (*Table 2*).

Table 1. *Biometric data for fish that was included in the analytical program. Analyses were mainly performed on pooled fish samples.*

	Valnesvatn (210)	**Holmvatn (324)**	**Langvatn (257)**	**Gavdnajavri (282)**	**Richardvatn (505)**	**Åsøvatn (506)**	**Ellasjøen (401)**	**Øyangen (402)**
Species	Trout	Trout	Trout	Perch	A. Char	A. Char	A. char	A. char
n	12	8	10	12	8	12	8	7
Average length (cm)	275	352	337	285	401	319	370	407
Range	(214 - 414)	(340 - 375)	(298 - 401)	(260 - 305)	(355 - 420)	(260 - 384)	(305 - 436)	(332 - 527)
Average weight (g)	289	448	413	323	540	299	509	886
Range	(106 - 755)	(374 - 555)	(285 - 676)	(264 - 418)	(412 - 702)	(153 - 496)	(330 - 818)	(510 - 1505)

Table 2. *Biometric data for Arctic char from Richardvatn and Åsøvatn that were analysed individually.*

Location	**Sample no.**	**Length**	**Weigth**	**Sex**
Richardvatn	R1	413	529	Male
Richardvatn	R2	420	575	Male
Richardvatn	R4	412	431	Male
Richardvatn	R5	405	702	Female
Richardvatn	R6	403	542	Male
Åsøvatn	Å9	582	2 400	Female
Åsøvatn	Å10	540	1 496	Male
Åsøvatn	Å11	501	1 956	Male
Åsøvatn	Å12	475	1 045	Male
Åsøvatn	Å13	428	705	Female

5.5 Analyses

All the analyses of POPs, and some analyses of PAH in sediments, were performed by Scientific Production Association "Typhoon", Center for Environmental Chemistry, Obninsk, Russia. Most of the PAH-analyses in sediments were performed by Unilab Analyse, Tromsø, Norway, while NIVA was responsible for analyses of heavy metals and loss on ignition (LOI).

5.5.1 Loss on ignition (LOI)

The sediment samples were dried at 60°C, homogenised and sieved through a net with mesh size of 70 µm to remove sand grains etc. Subsequently, the samples were combusted at 550ºC, and the LOI was calculated from the weight loss. Statistical tests have shown that organic carbon (OC), together with water from crystallised iron-hydroxide, is included in the values for LOI. The sediment samples had LOI-values that were above 5 %, and previous investigations have shown that the organic content in such samples are approximately 50 % of the LOI-value (see Rognerud *et al.* 2000).

5.5.2 Metal extraction and quantification, sediment samples

A HR-ICPMS (High Resolution Inductively Coupled Plasma Mass Spectrometry) was used for metal analysis. This method is a development of the ICPMS technology. The analytical method is optimised in order to remove the most common molecule ions by using MR (Medium Resolution at 3000) and HR (High Resolution 10000). The calibration is performed with multi standards with the same concentrations of nitric acid (matrix matched) as in the nitric acid solution from the dissoluted sediment samples. In addition 5 internal standards that are optimized to compensate for the variation in ionisations efficiency and variations in response over the mass range from 5 to 240 are used.

5.5.3 PAH extraction and quantification, sediment samples

Unilab Analyse: Methanol (100 ml) and kaliumhydroxyd (3 g) was added to approximately 2 g of sediment together with 1 ml of a solution containing internal standards (naphthalen-d_8, biphenyl-d_{10}, antracene-d_{10}, phenantrene-d_{10}, pyren-d_{10}, chrysen-d_{12} and perylen-d_{12}). The mixture was refluxed for 1.5 hour before the methanol was extracted with pentane. The pentane extract was evaporated using a rotavapour. The extracts were cleaned on extraction columns containing 500 mg of silica. Then the PAHs were eluted with pentane and dichlormethane. The samples were evaporated using nitrogen before 100 µl isooctane was added. Aromatic and bicyclical compounds were determines using Hewlett-Packard MS 5971 and Hewlett-Packard 5890 gas-chromatographs.

Typhoon: Sediment samples from 11 lakes (no. 224, 232, 274, 285, 300, 301, 402, 501, 503, 505 and 506) were analysed by Center for Environmental Chemistry (Typhoon) in Moscow. The samples were dried and homogenised. Ultrasonic extraction procedures were used to determine PAHs. The analytical procedure is given in *Figure 5*.

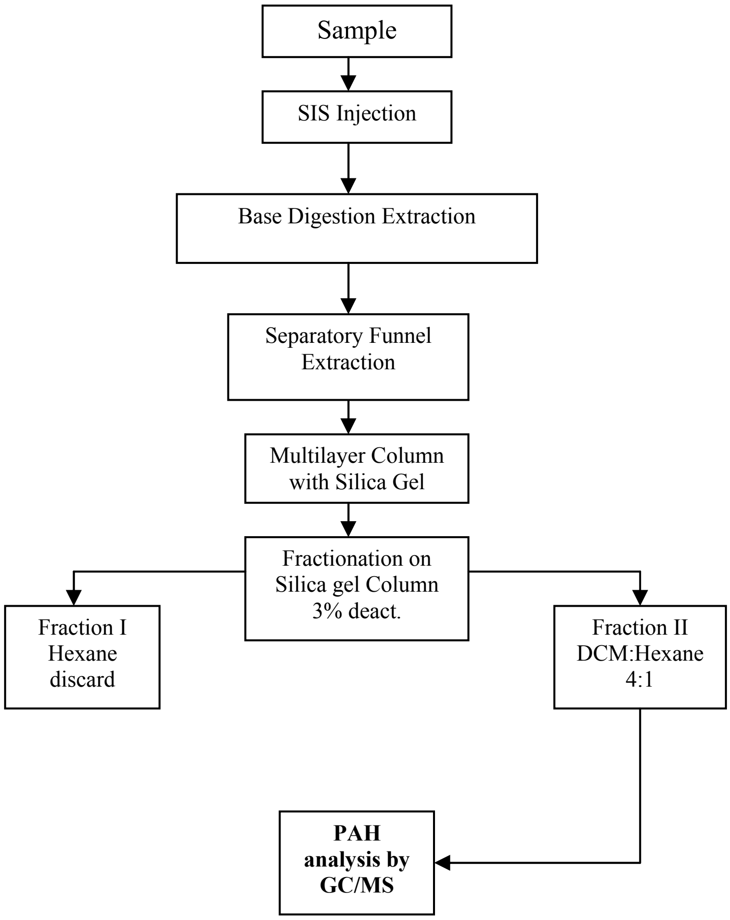


Figure 5. *A schematic overview of PAH analyses in sediment at Typhoon.*

5.5.4 POP extraction and quantification, sediment samples

Extraction of sediments was carried out in Soxhlet apparatus over a 16 hour period using a solvent mixture of benzene-ethanol. Determinations of PCBs, chlorinated pesticides, PCDD/PCDFs, PBDEs and planar congeners of PCBs were carried out from the same extracts.

PCBs and chlorinated pesticides were quantified using a GC/MS Varian Saturn 2200 T. Calibration of the instrument was carried out using a standard mixture of biphenyls BP-MS, Wellington Laboratories and SRM-1492, NIST. The results of the analyses were processed with the software package Varian 5.2.

Polychlorinated dibenzo-p-dioxins/dibenzofurans (PCDD/PCDFs) and Polybrominated diphenyl ethers (PBDEs) were quantified using a GC/MS Varian Saturn 1200 using chemical ionization with detection of negative ions (NCI) in the selective ion monitoring (SIM) mode. The reagent gas was methane. Calibration of the instrument was carried out with standard solutions of PCDD/PCDF prepared on the base of the mixture EDF 7999 Cambridge Isotope Lab. and standard solutions of PBDE prepared on the base of the mixture EO-4980, Cambridge Isotope Lab.

5.5.5 Metal extraction and quantification, fish samples

Cd, Co, Cr, Cu, Ni, Pb were measured by furnace technique on Perkin Elmer Z-3030 with Zeeman correction of background after ashing at 450 °C and solution in nitric acid.

Zn was measured by AAS method by flame procedure on Perkin Elmer B-3030 after ashing at 450°C and solution in nitric acid.

Hg was measured by standard addition method after decomposition of the samples with H_2SO_4 (sulphuric) and HNO_3 (nitric) acids on MHS 15.

As was measured by the borhydrid method on MHS 15 after decomposition of the samples by mixture of sulphuric and perchloric acids.

Extraction of Se was carried out with mixture of H_2SO_4 (sulphuric) and $HClO_4$ (chlorine) acids, then conversion of Se to 5-nitro-2,1,3-benzoselendiasol and extraction with chloroform. Se was measured by unflame technique on Perkin Elmer Z-3030 with Zeeman correction of background.

5.5.6 PAH extraction and quantification, fish samples

The PAHs were extracted from the fish tissues with methanol and 50% KOH solution (base digestion). The analytes were extracted from base solution with two portions of hexane in a separator funnel. Ultrasonic extraction procedures were used to determine PAHs (see *Figure 5*).

5.5.7 POP extraction and quantification, fish samples

POPs were extracted from fish tissue samples using a mixture of hexane and dichlormethane (1:1 (v/v)) in a column extraction method. Lipid content was determined gravimetrically from 10% of the extract volume. Fifty % of extract volume was used for clean up for PCDD/Fs and PBDEs analysis, while the remaining 40% was used for clean up for other POPs analysis. Polychlorinated dibenzo-p-dioxins/dibenzofurans (PCDD/PCDFs) and Polybrominated diphenyl ethers (PBDEs) were quantified using a GC/MS Varian Saturn 1200 using chemical ionization with detection of negative ions (NCI) in the selective ion monitoring (SIM) mode. The reagent gas was methane. Calibration of the instrument was carried out with standard solutions of PCDD/PCDF prepared on the base of the mixture EDF 7999 Cambridge Isotope Lab. and standard solutions of PBDE prepared on the base of the mixture EO-4980, Cambridge Isotope Lab.

5.5.8 Quality assurance/Quality control

Quality assurance and quality control for heavy metals included analysis of blanks, analysis of duplicates, use of reference materials and matrix spike recoveries.

The internal QA/QC program in samples analysis for organic pollutants involved control for possible contamination of samples during sample preparation and measurements. Samples were analysed in batches, which included laboratory procedural blanks, spiked matrix samples and samples of standard reference material. To control recovery of analytes surrogate isotope-labelled substances have been used, which were introduced into samples before extraction.

5.6 Data treatment

5.6.1 Enrichment factors and time trends

Metals are naturally occurring in the environment, and therefore the local geology will affect metal concentrations in soil and sediments. Differences in geology complicate comparisons of metal levels between different areas. A common method to interpret results from metal analyses is therefore to compare levels in pre-industrial sediment with levels in sediment closer to surface. In order to do this we have calculated enrichment factors (K_f) or contamination factor which are the ratio between surface sediment and reference sediment (ratio: surface/reference) (Håkanson 1984).

In the interpretation of the results obtained, it must be emphasised that the enrichment factor and concentrations found in this study only reflect the concentrations and degree of enrichment of the metals analysed. These enrichment factors are not a direct measurement of anthropogenic pollution, but also include the effects of all natural enriching and diluting processes in the sediment. However, the principle of expressing the degree of impact on the basis of K_f values is generally accepted, based on the hypothesis that anthropogenic pollution is often the most important cause of high K_f values, and the fact that the degree of enrichment is the levels to which aquatic organisms are exposed, regardless of cause.

The classification of the degree of enrichment is presented in *Table 3*. The classification is a modification of the terminology used in Holtan and Rosland (1992).

Table 3. *Classification of the degree of enrichment, based on the enrichment factor (K_f).*

Degree of enrichment	Colour on the map	K_f-factor
Extremely enriched	(red)	> 10.0
Severely enriched	(orange)	5.0 – 10.0
Markedly enriched	(yellow)	3.0 – 5.0
Moderately enriched	(green)	1.5 – 3.0.
Not or slightly enriched	(blue)	< 1.5

In order to investigate more recent changes in metal deposition we looked at the changes in concentrations between the surface sediment (0 - 0.5 cm) and the section from 0.5 - 1.0 cm.

6. Results of sediment survey

6.1 Loss on ignition (LOI)

There is no clear pattern of the amount in organic content (Loss on ignition = LOI) in surface sediment in the studied area (*Figure 6*). The LOI level varies from 6.5% to 57.8% with a median value of 23.8%. The organic content in the lake sediment on Svalbard varies very much (6.5% to 57.7%) and the LOI levels seem to be strongly influenced by seabird activity in the catchment area of the lake. Lake Ellasjøen (401) on Bjørnøya, Lake Arressjøen (501) and Lake Åsøvatn (506) are all strongly influenced by seabirds.

There is a clear trend in most of the lakes that the surface layer has a slightly higher organic content compare to the subsurface layer (0.5 - 1.0 cm) (*Figure 7*). The median value is 23.8% for the surface section and 22.3% for the subsurface section respectively (17.0% for the reference section). This is due to natural breakdown of the organic content in the sediment.

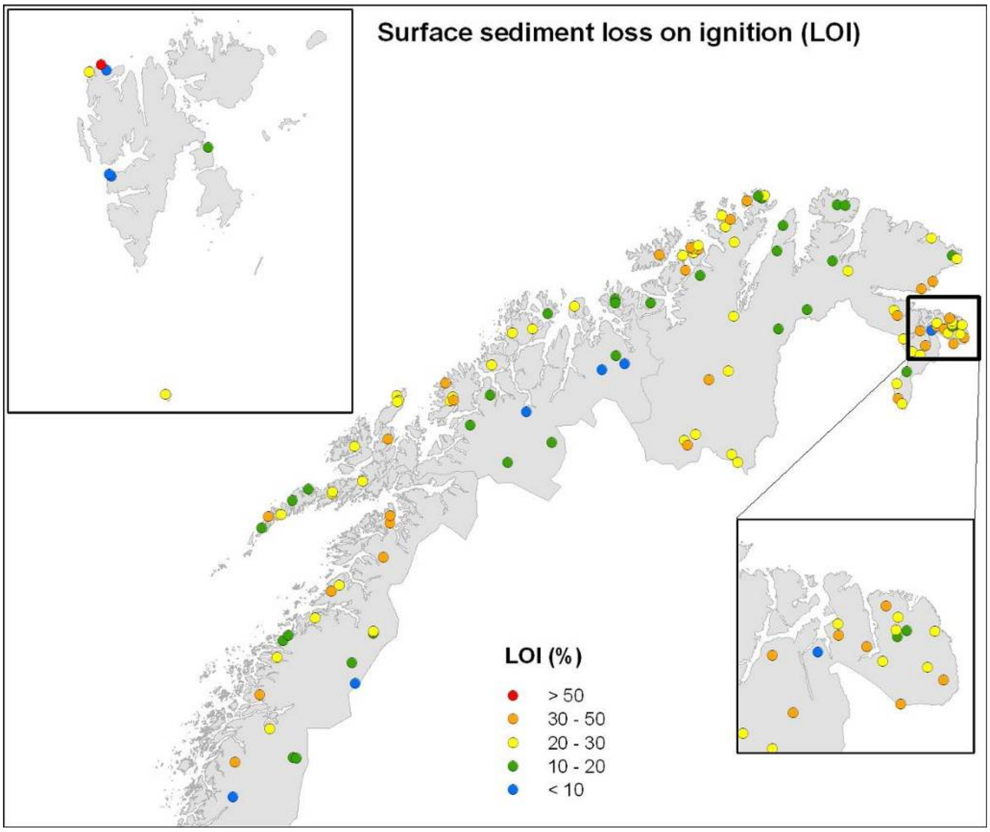


Figure 6. *Loss on ignition (LOI) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

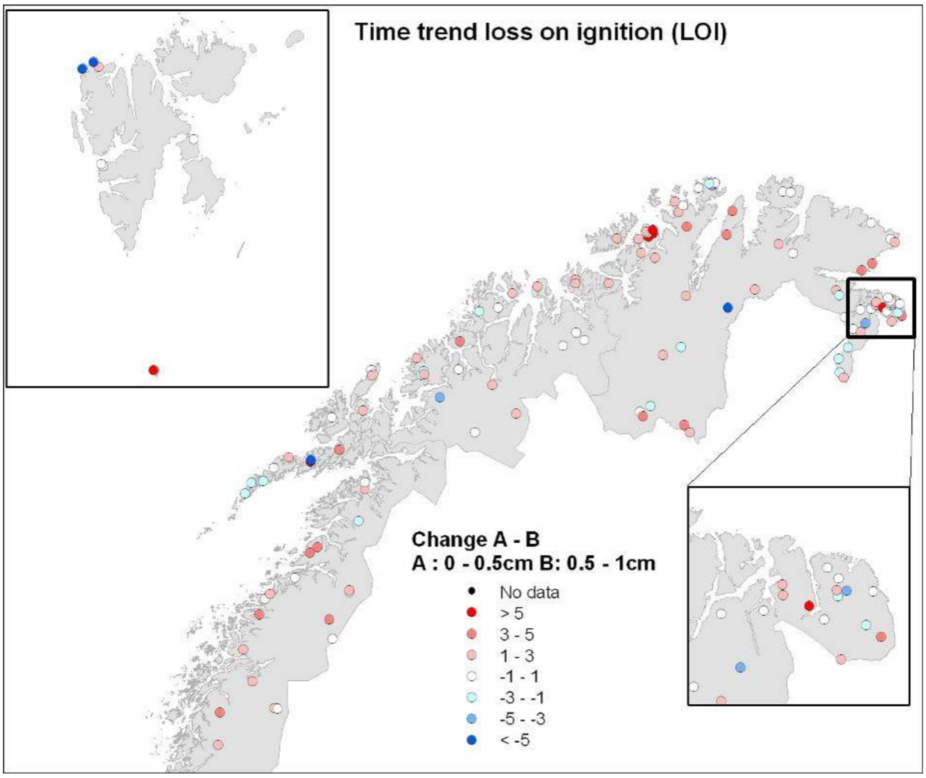


Figure 7. *Differences in loss on ignition (LOI) between surface layer (0-0.5 cm) and subsurface layer (0.5 - 1.0 cm).*

Langvatn (257) on Sørøya, Finnmark (photo: G. N. Christensen).

6.2 Metals

6.2.1 Mercury (Hg)

Generally the highest concentration of mercury (Hg) in the sediment surface layer (0-0.5 cm) was recorded in the lakes along the coast (*Figure 8*). In addition, elevated levels were recorded in lakes in the eastern part of Finnmark County (Sør-Varanger municipality). The median value for the 122 investigated lakes was 0.15 µg/g dw. The lowest levels (< 0.1 µg/g dw) were recorded in the central part of Finnmark County and in the inner part of Troms County. The mean levels of Hg in the lakes on Svalbard (0.13 µg/g dw) and were slightly lower compared to the levels on the mainland (0.16 µg/g dw). The highest levels of Hg in the Svalbard lakes were recorded in lakes that are influenced by seabirds (Lake Arressjøen, Lake Åsøvatn and Lake Ellasjøen). The concentrations in the lakes in AMAP region are low compared to levels in the southern part of Norway (Rognerud *et al.* 2008).

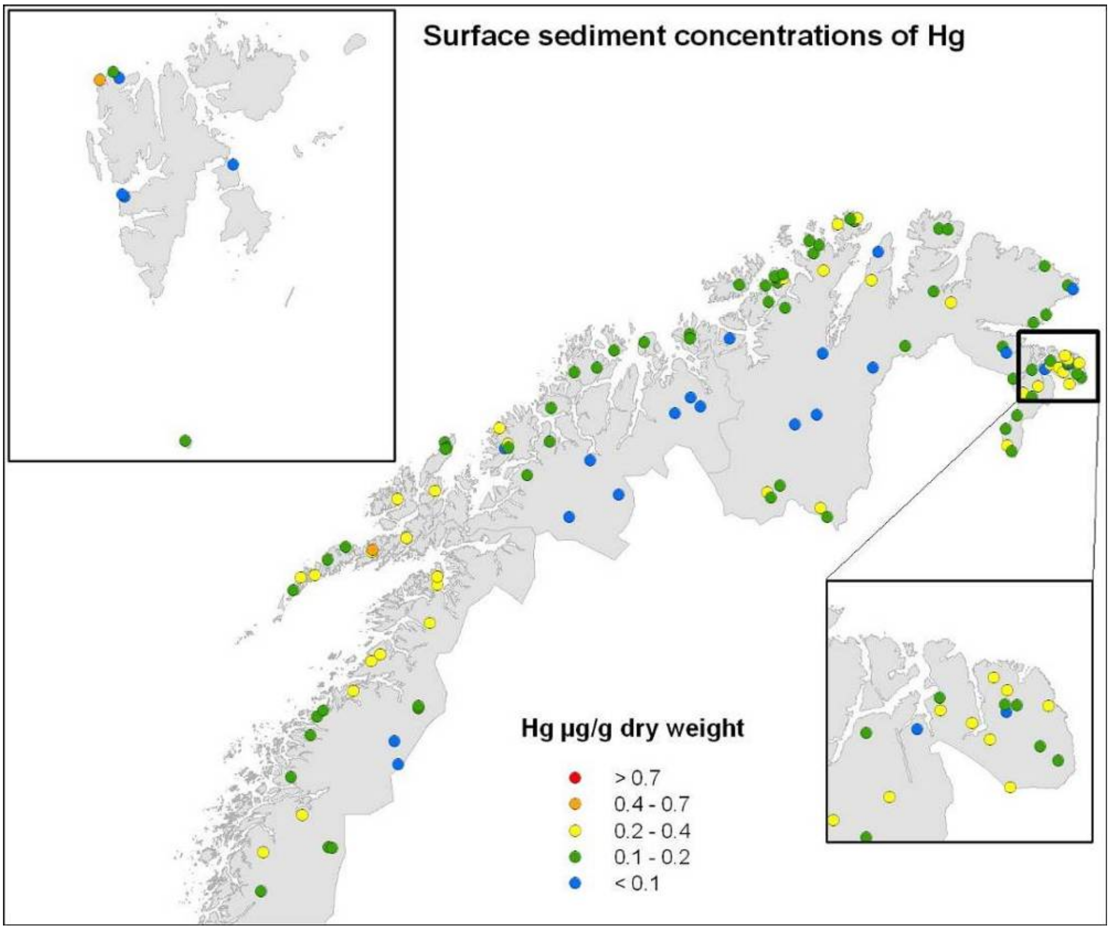


Figure 8. *Concentrations (µg/g dw) of mercury (Hg) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

Enrichment factors for Hg indicate that most of the lakes are moderately to markedly enriched with mercury (*Figure 9*). The general picture indicates that the lakes along the coast are more enriched than the lakes further inland. The highest enrichment factors were observed in some of the lakes in eastern Finnmark County (severely to extremely enriched). This is probably caused by emissions from the smelters in Nickel (Russia). The 3 lakes on the Northwest part of Svalbard and Lake Ellasjøen on Bjørnøya are categorised as moderately enriched with Hg.

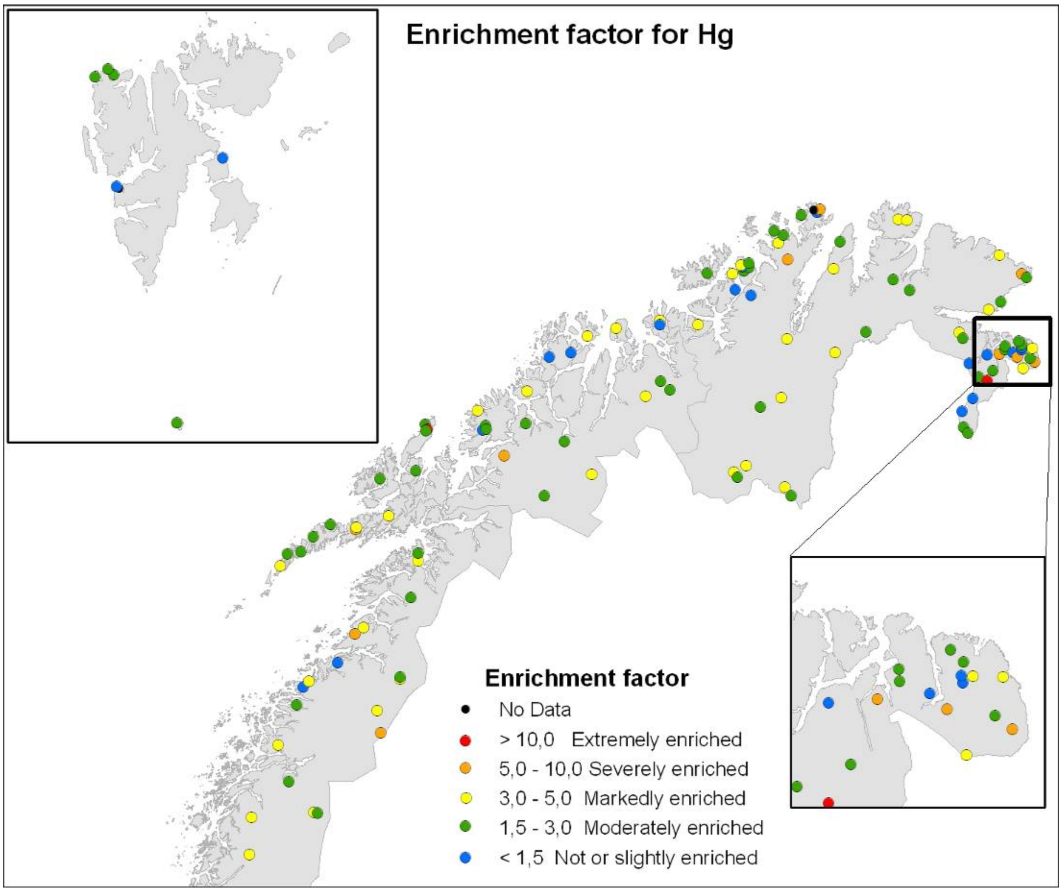


Figure 9. *Enrichment factor for mercury (Hg) in surface sediment in lakes on the mainland of Northern Norway and on Svalbard.*

Changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals a slight increase in concentrations (*Figure 10*). The highest increase occurs along the coast and in eastern Finnmark. There are no changes in the Svalbard lakes.

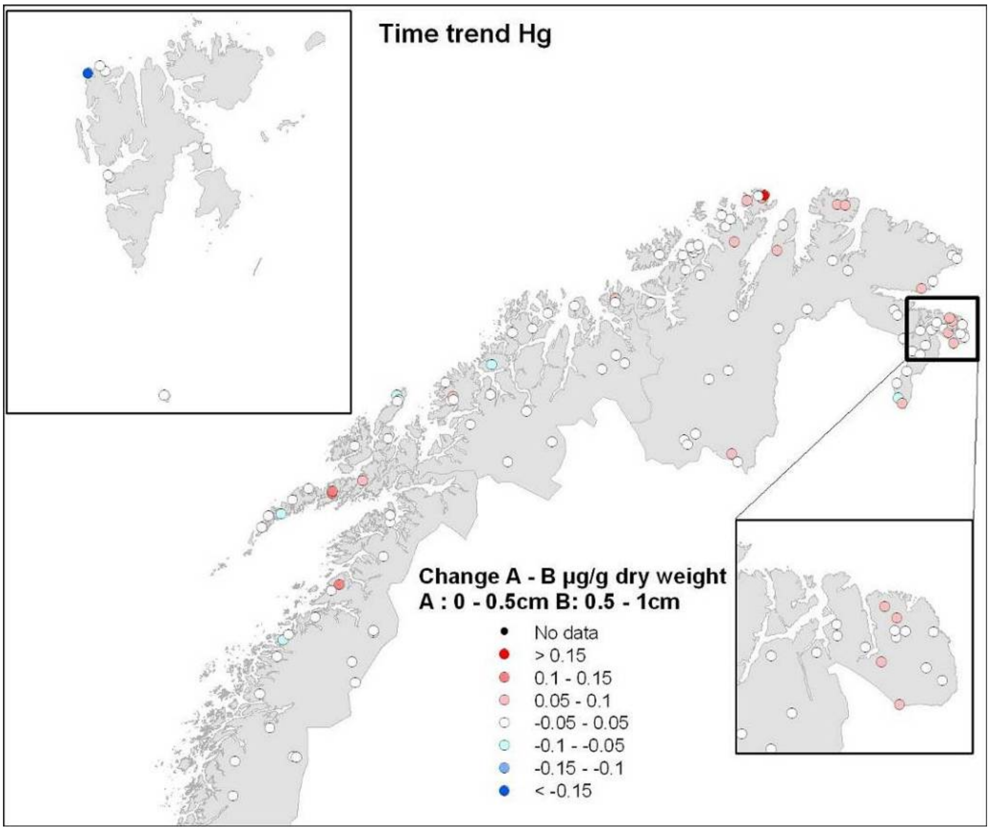


Figure 10. *Differences in concentrations (µg/g dw) of mercury (Hg) between surface layer (0-0.5 cm) and subsurface layer (0.5 - 1.0 cm).*

There is often an association between the concentration of most of the metals and POPs and the organic content in the sediments. In this study there was a weak clear correlation between the organic content and the mercury levels in surface sediment (*Figure 11*). However for most of the other metals there were low correlation (R^2<0.10). One of the explanations for this is the generally low atmospheric deposition of the different metals in the region. In addition regional differences in geology and thereby natural differences in metal concentration in the studied area camouflage the correlation between organic content and levels of metals.

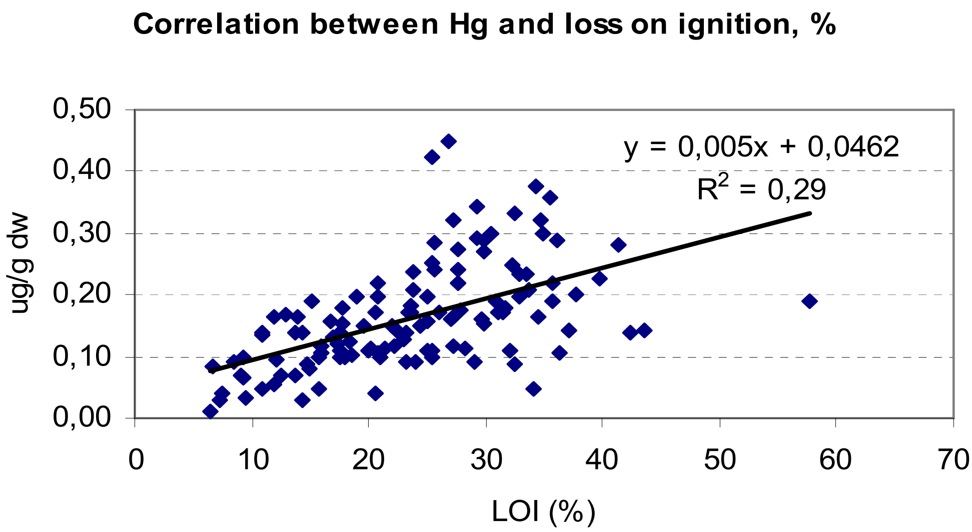


Figure 11. *Correlation between mercury (Hg) and loss on ignition in the investigated lakes (n=122).*

6.2.2 Lead (Pb)

The concentrations of lead (Pb) are markedly elevated along the whole coast (*Figure 12*). In general the highest levels were recorded along the coast of Nordland County. However, lake with the highest level was recorded in Bakkatækjavri in Finnmark County (248 µg/g dw). The median value for all the lakes that are included in this study was 57 µg/g dw. The lowest concentrations were observed in the lakes in the inner part of Finnmark County. The highest concentration on Svalbard was observed in Lake Ellasjøen. The reason for this is the high natural content of lead in the bedrock on Bjørnøya.

The enrichment factor plot clearly reveals that the investigated area is generally markedly to severely enriched with Pb (*Figure 13*). The highest enrichment has occurred in the coastal areas of Nordland and in some lakes in the inner and eastern part of Finnmark. The lakes on Svalbard seem to be only slightly enriched.

The figure showing changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals few changes in the region (*Figure 13*). However, in some of the lakes in the northern part of Nordland County, along the coast of Finnmark and in the eastern part of Finnmark County the levels have increased toward present time. There are no recent changes in the lakes on Svalbard.

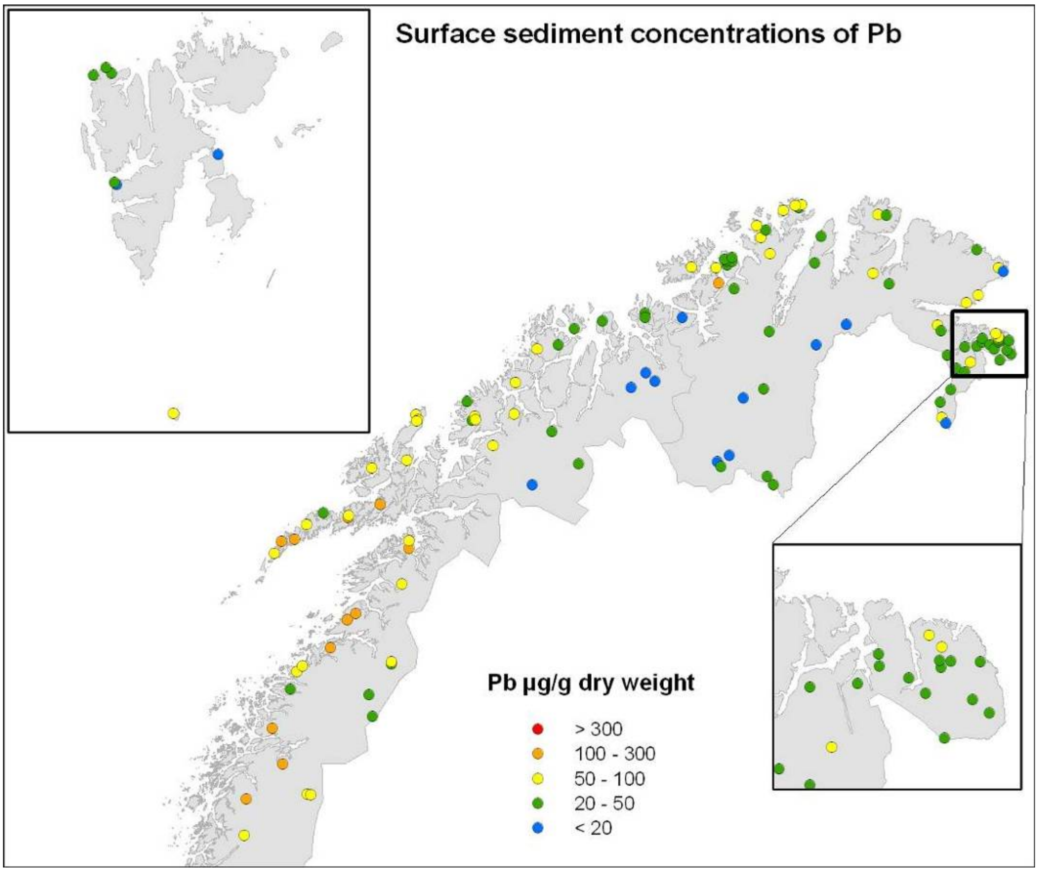


Figure 12. *Concentrations (µg/g dw) of lead (Pb) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

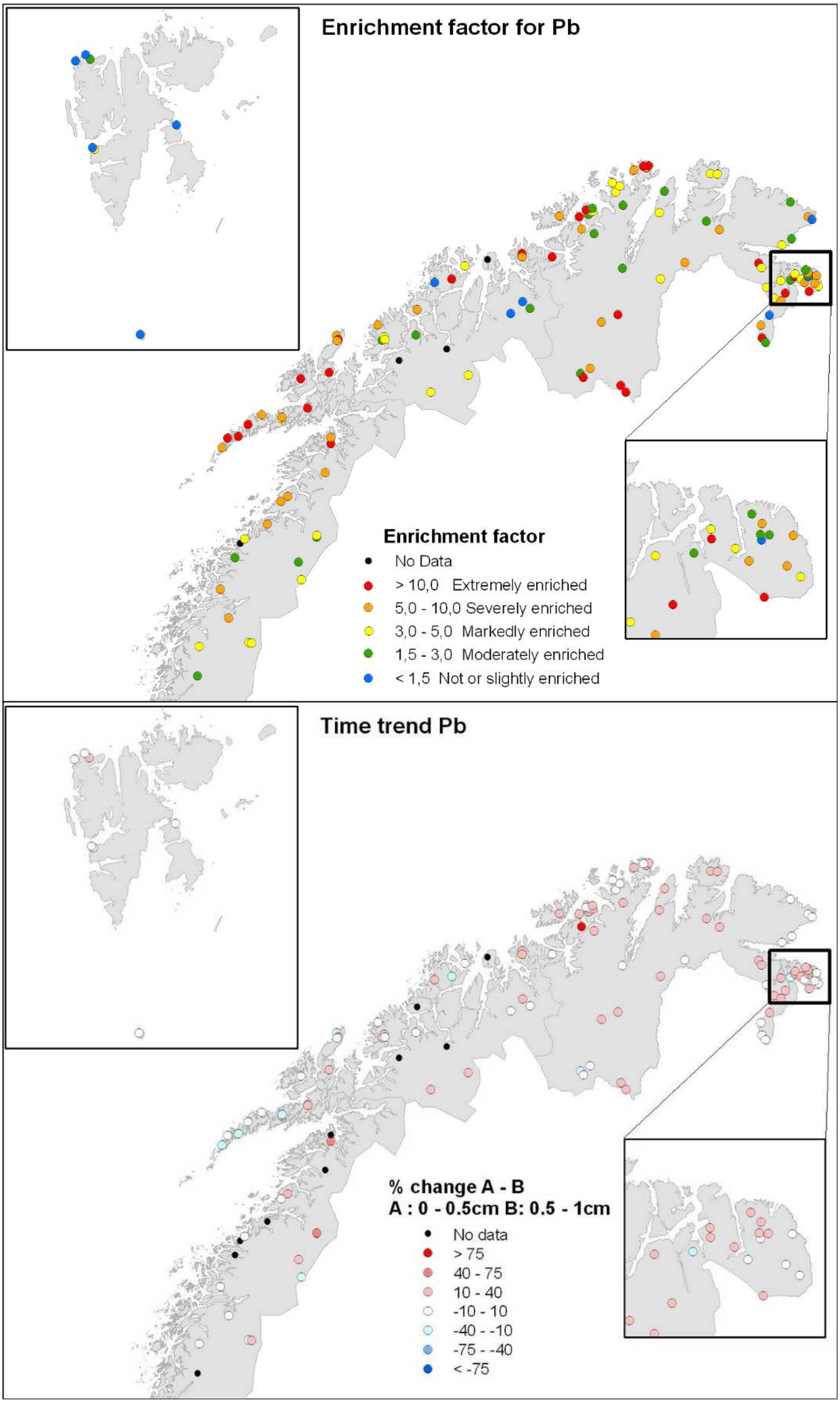


Figure 13. *Enrichment factor for lead (Pb) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Pb between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.3 Cadmium (Cd)

The concentrations of cadmium (Cd) in lake surface sediments are generally low from the whole region, with a median level at 0.59 µg/g dw (*Figure 14*). However, there are elevated levels in some few lakes. The levels in surface sediment in Lake Åsøvatn (3.73 µg/g dw), on Svalbard and Lake Ellasjøen (2.81 µg/g dw) on Bjørnøya, were relatively high. These elevated levels are mainly due to higher content in the bedrock because the levels are equally high in the reference sediment. The cadmium levels in the region are in the same range as levels reported from other Arctic areas (AMAP 2005).

The plot of the enrichment factors for the region reveals that the region in general is slightly to moderately enriched with Cd (*Figure 15*). There are a few lakes that can be categorised as severely enriched but no clear distribution patter can be seen.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveal only small changes and no particular trends for the region (*Figure 15*). No changes could be observed for the lakes on Svalbard.

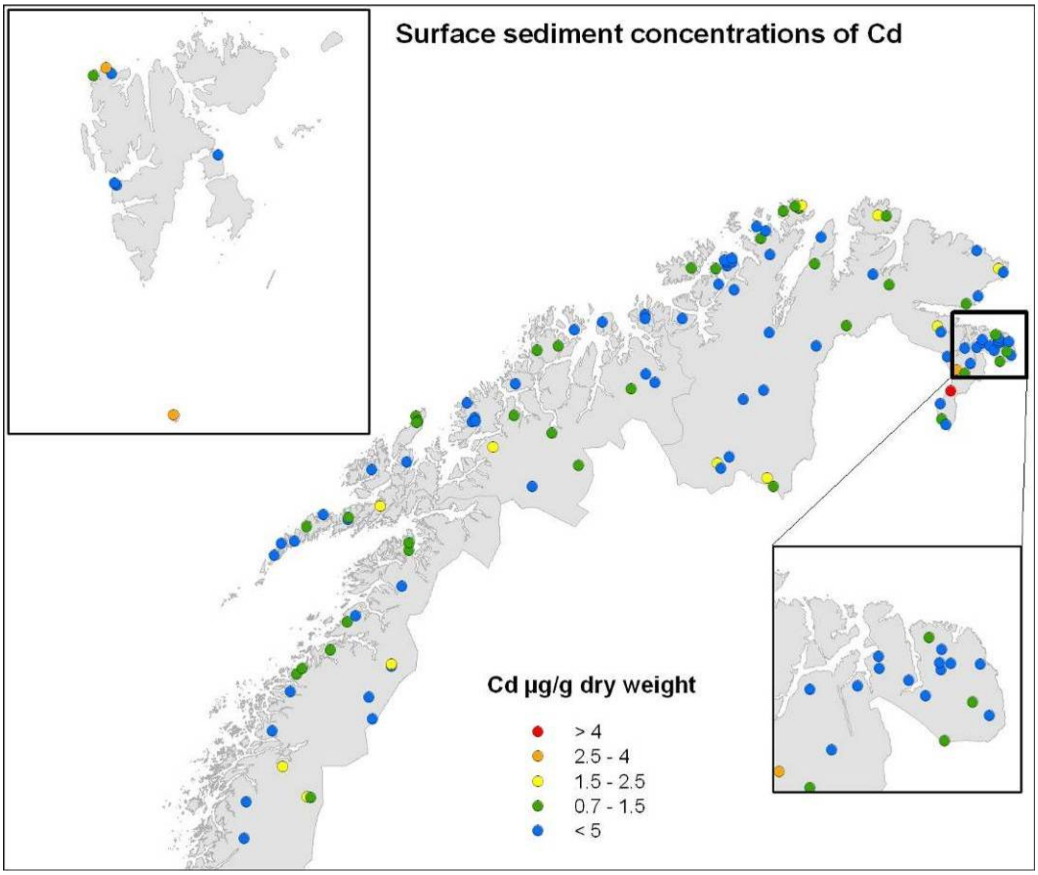


Figure 14. *Concentrations (µg/g dw) of cadmium (Cd) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

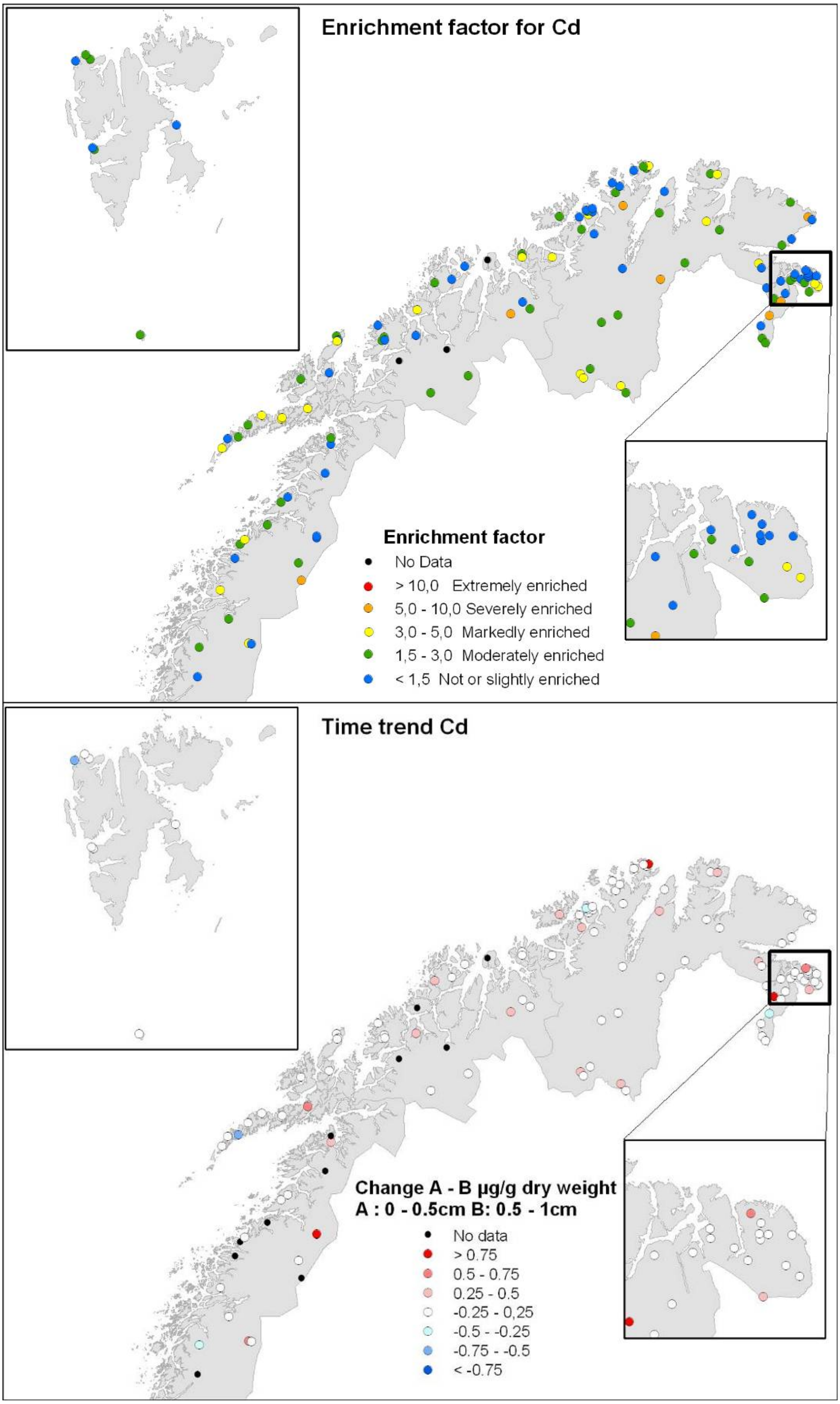


Figure 15. *Enrichment factor for cadmium (Cd) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Cd between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.4 Antimony (Sb)

The highest concentrations of antimony (Sb) in surface sediment were measured in the lakes located along the coast of Nordland County with levels up to 0.86 µg/g dw (*Figure 16*). The lowest levels were found in the inner part of Troms and Finnmark County and on Svalbard. The median value for the whole region was 0.42 µg/g dw. The levels in the lakes on Svalbard were low (0.03 - 0.07 µg/g dw).

The enrichment factor plot clearly reveals that sediments from lakes in Lofoten and Vesterålen in Nordland County and the eastern and inner part of Finnmark County are severely to extremely enriched with antimony (*Figure 17*). There are no clear trends for the lakes on Svalbard, that are from slightly to extremely enriched with antimony.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals no recent changes in the region (*Figure 17*).

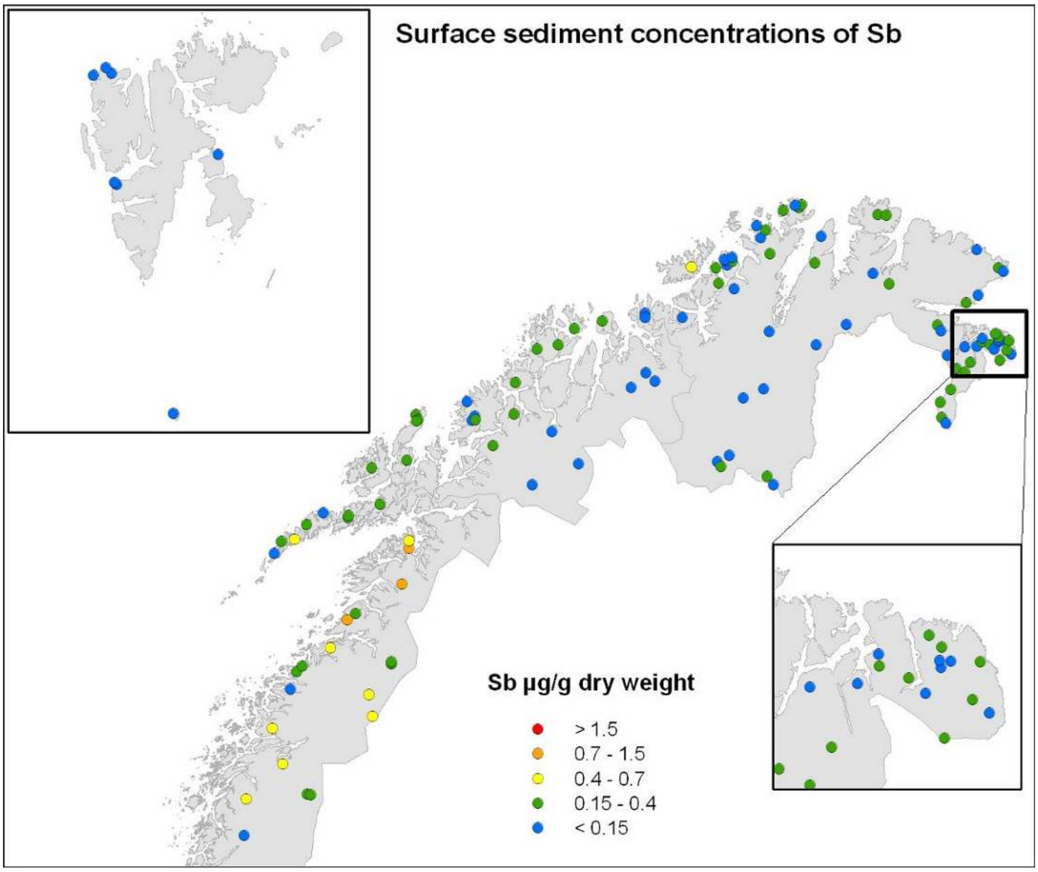


Figure 16. *Concentrations (µg/g dw) of antimony (Sb) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

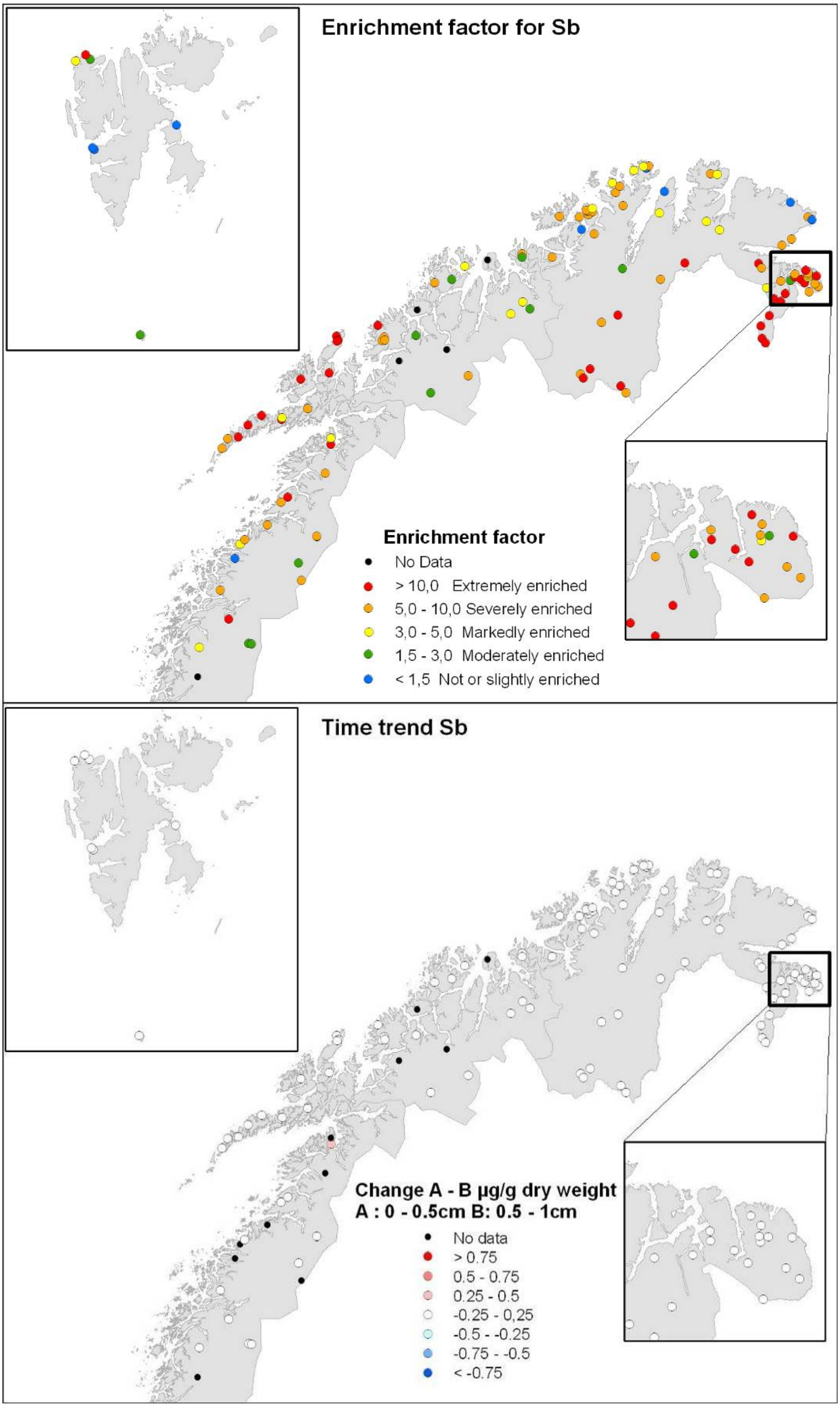


Figure 17. *Enrichment factor for antimony (Sb) in surface sediments (upper figure) and differences in concentrations of Sb (µg/g dw) between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.5 Bismuth (Bi)

The levels of bismuth (Bi) were highest along the coast and in eastern Finnmark, with levels up to 2.07 µg/g dw (*Figure 18*). The concentrations in the lakes in the study area are considerably lower compared to the levels recorded in the southern part of Norway (Rognerud *et al.* 2008). The median concentration for the AMAP area was 0.48 µg/g dw.

It is clear that Lofoten and Vesterålen in Nordland County and the eastern part of Finnmark are the most enriched areas. Most of the lakes in these areas are categorised as severely to extremely enriched with Bi (*Figure 19*. The lakes on Svalbard are only slightly to moderately enriched.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals very little recent change for the region (*Figure 19*). There have been no changes in the lakes on Svalbard.

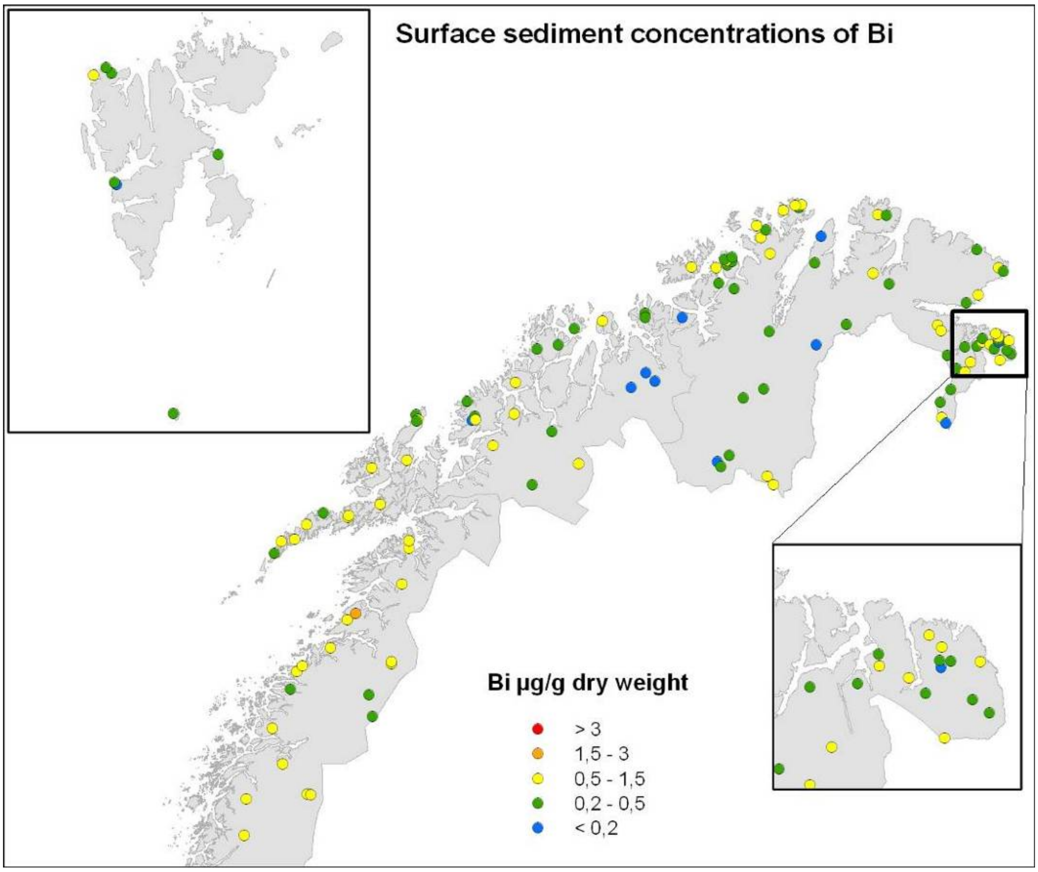


Figure 18. *Concentrations (µg/g dw) of bismuth (Bi) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

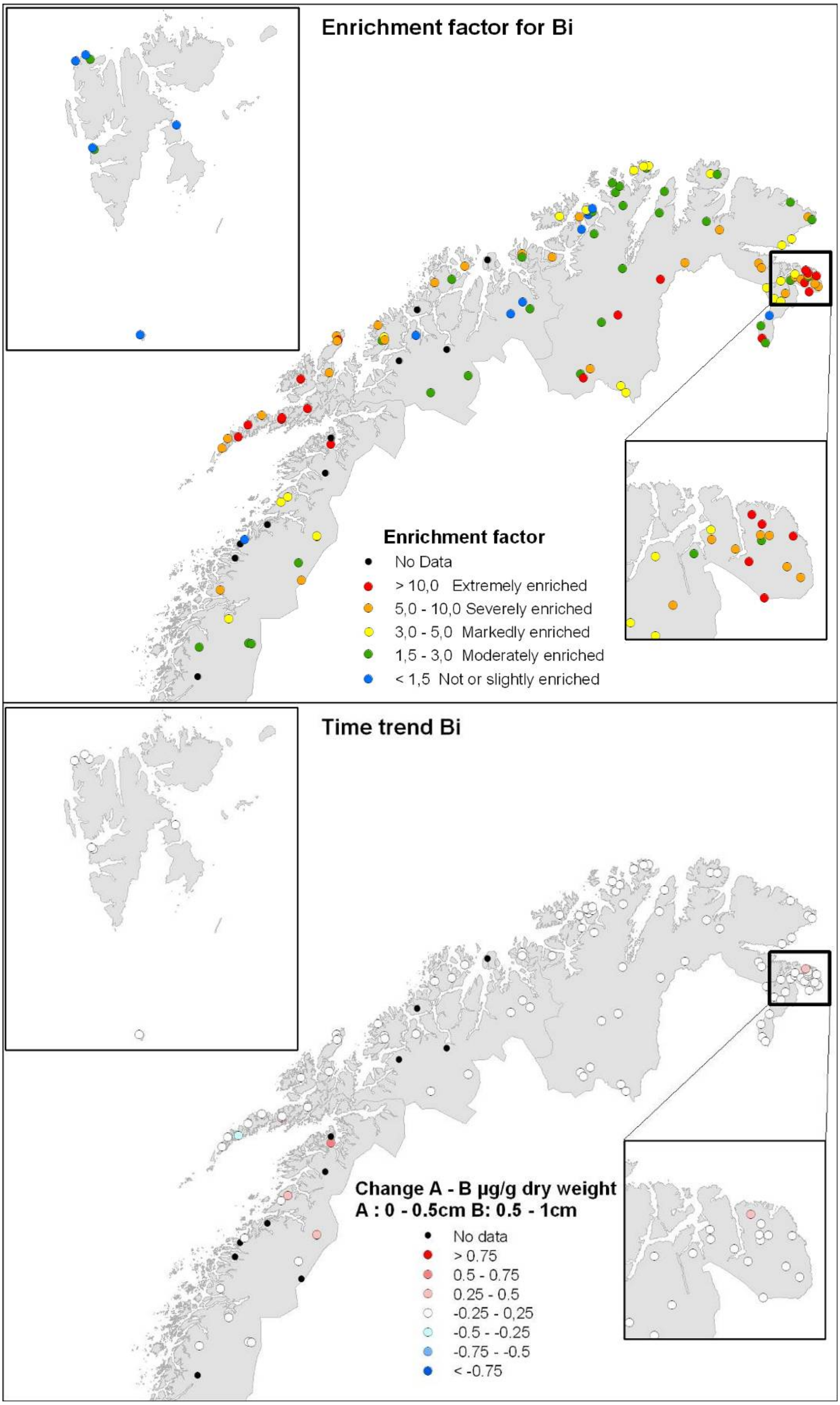


Figure 19. *Enrichment factor for bismuth (Bi) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Bi between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.6 Arsenic (As)

Elevated levels of arsenic (As) in surface sediment were found in the lakes along the coast and in eastern Finnmark County (*Figure 20*). Some of the highest values were recorded in sediments from lakes in Troms County, but these are due to high background levels. The lowest levels were recorded in the inner part of Finnmark County. The median concentration of arsenic in surface sediment for all the lakes in this study was 8.96 (µg/g dw).

The lakes along the coast and in eastern Finnmark were the most enriched lakes (*Figure 21*). On Svalbard it seems that lakes that are influenced by seabirds are more strongly enriched than other lakes.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals no changes or a slight decrease in Nordland and Troms Counties (*Figure 21*). In the eastern part of Finnmark County there has been a slight increase in some of the lakes. The level in some lakes seems to have increased considerably. However, As is a redox sensitive metal and Fe/Mn can therefore influence the concentration differences in surface sediments without an increase in the concentration can be related to long range atmospheric transport of arsenic. The time trend on Svalbard seems stable however the concentration of As in Lake Ellasjøen on Bjørnøya seems to increase.

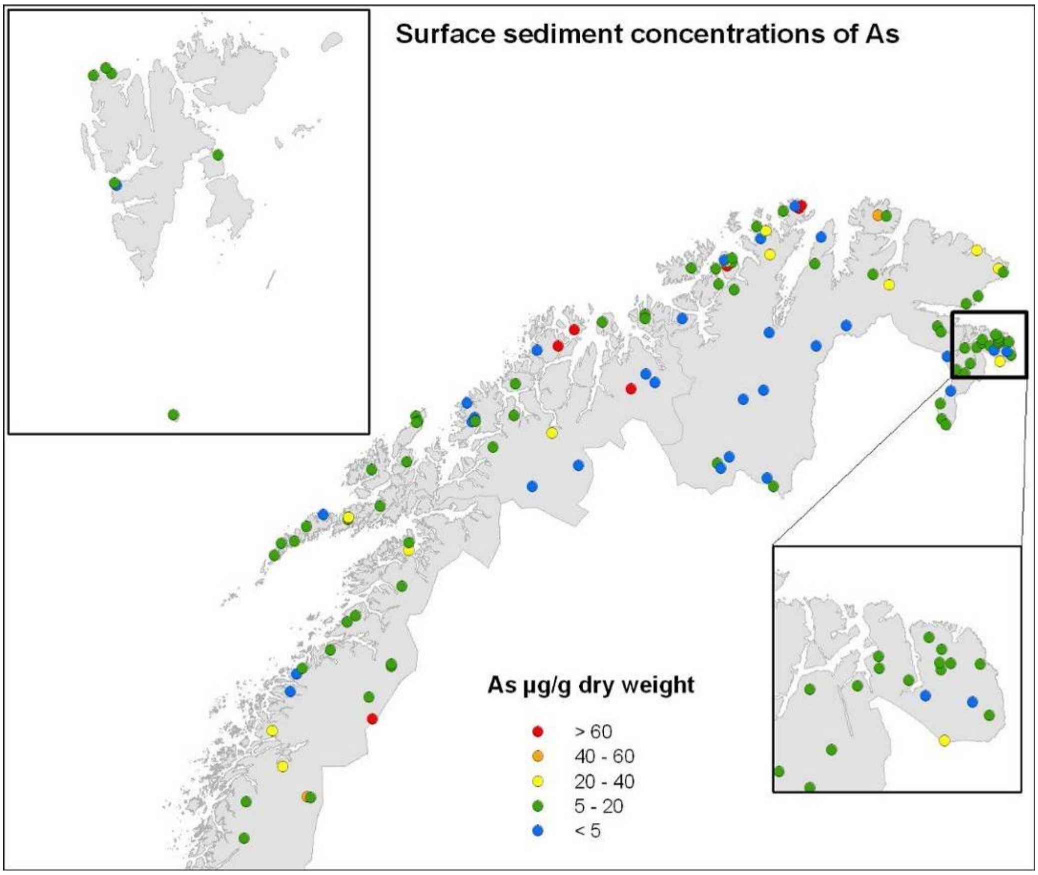


Figure 20. *Concentrations (µg/g dw) of arsenic (As) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

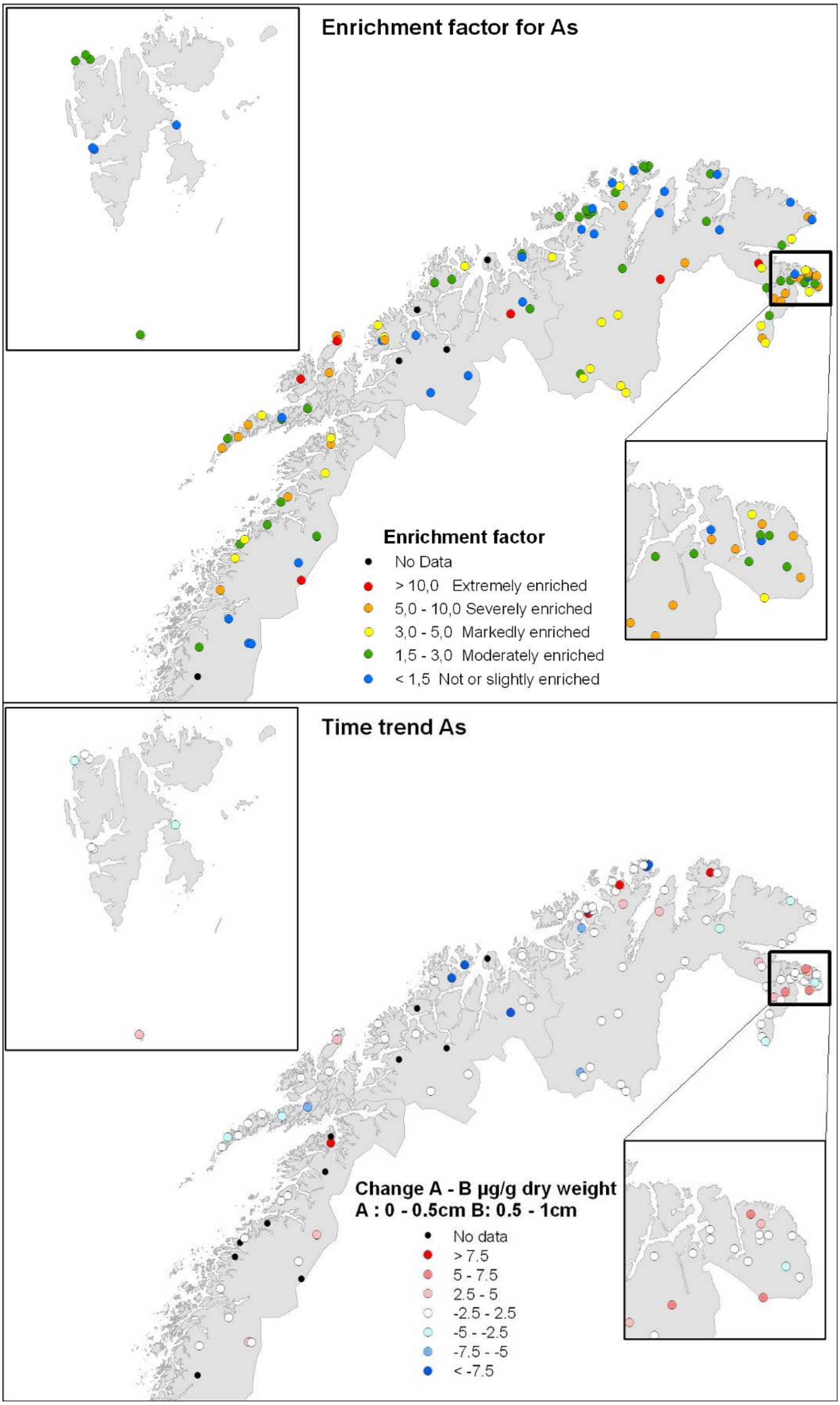


Figure 21. *Enrichment factor for arsenic (As) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of As between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.7 Tin (Sn)

The concentrations of tin (Sn) are generally low in the region (*Figure 22*) with a median concentration on 0.42 µg/g dw. The highest levels were recorded in Nordland County and especially along the coast. The levels are considerably below the concentrations found in lakes in the southern part of Norway (Rognerud *et al.* 2008).

The plot of enrichment factor reveals no clear pattern for the region (*Figure 23*). Many of the lakes are severely to extremely enriched with Sn. The lakes on Svalbard are slightly to moderately enriched with Sn.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals a slight decrease in Nordland, while there are no changes in the rest of the study area (*Figure 23*).

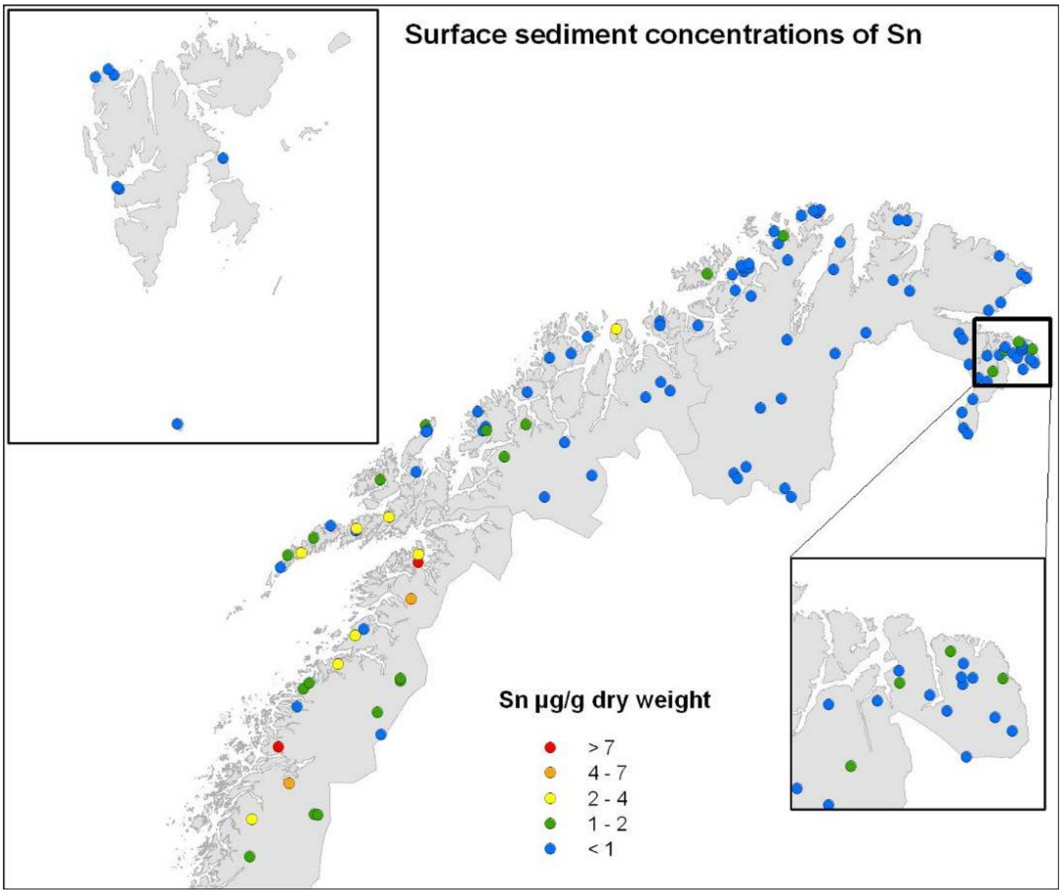


Figure 22. *Concentrations (µg/g dw) of tin (Sn) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

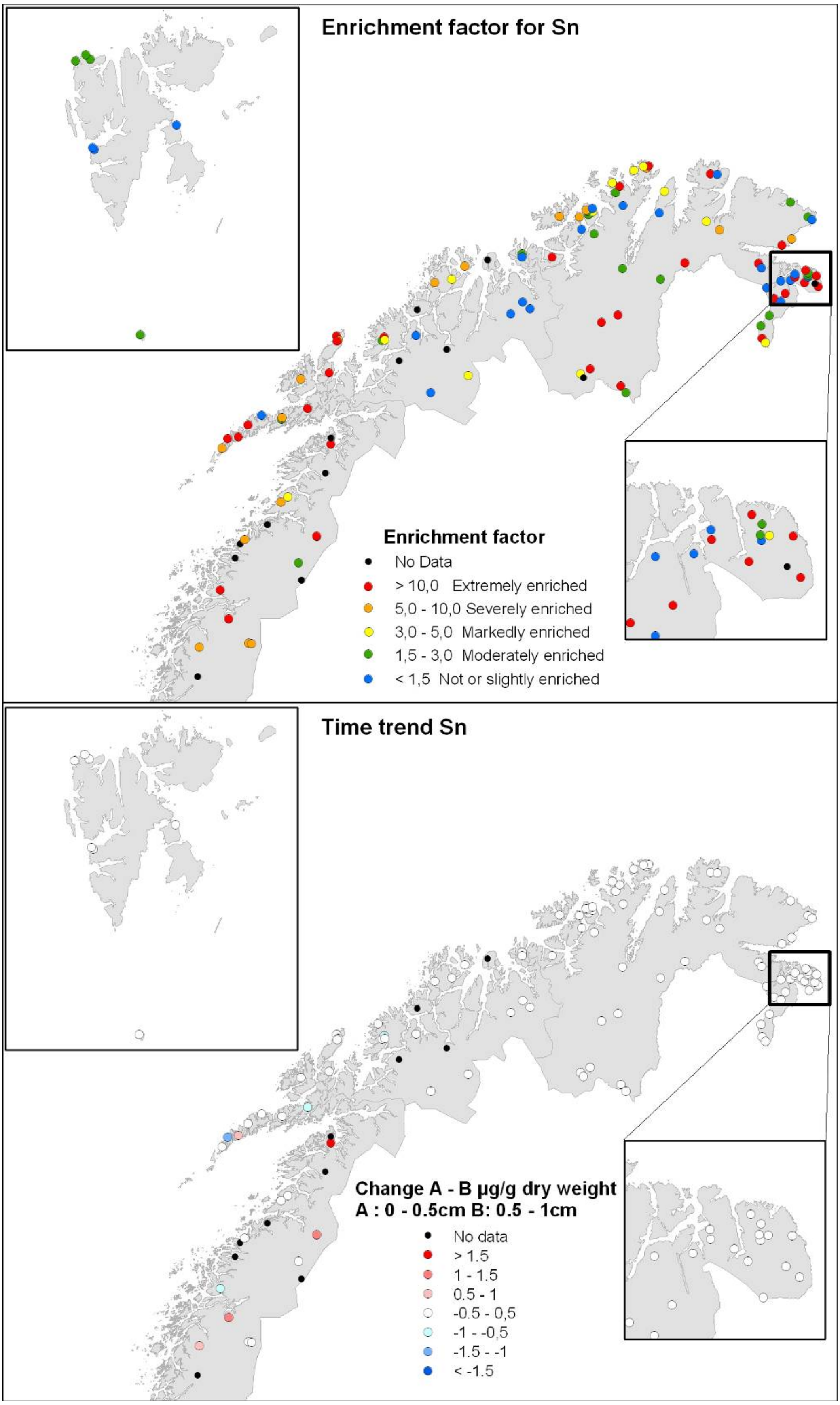


Figure 23. *Enrichment factor for tin (Sn) in surface sediments (upper figure) Differences in concentrations (µg/g dw) of Sn between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.8 Tellurium (Te)

Concentrations of tellurium (Te) in surface sediments were highest in the coastal areas and in the eastern part of Finnmark County (*Figure 24)*. The lowest levels were recorded in the inner part of Finnmark County. The levels in surface sediment on Svalbard were relatively high and comparable with the levels in the coastal lakes on the mainland. The high levels on Svalbard can be explained by higher background levels (high levels also in reference sediment). The levels in the studied area (median value 0.26 µg/g dw) are comparable to levels in the southern part of Norway (Rognerud *et al.* 2008).

Lakes in Lofoten / Vesterålen in Nordland County and the eastern part of Finnmark are categorised as severely to extremely enriched with tellurium (*Figure 25*). The lakes on Svalbard are only slightly enriched with tellurium.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), indicates only small changes in concentrations over past few decades (*Figure 25*). However, a slight increase seems to have taken placea in the Lofoten / Vesterålen area and in eastern Finnmark. The increase of Te in the lakes in eastern Finnmark (Jarfjord area) is related to the activity at the smelters in Nikel, Russia where they use ore that contains Te. The reason for the increase in Lofoten is unknown.

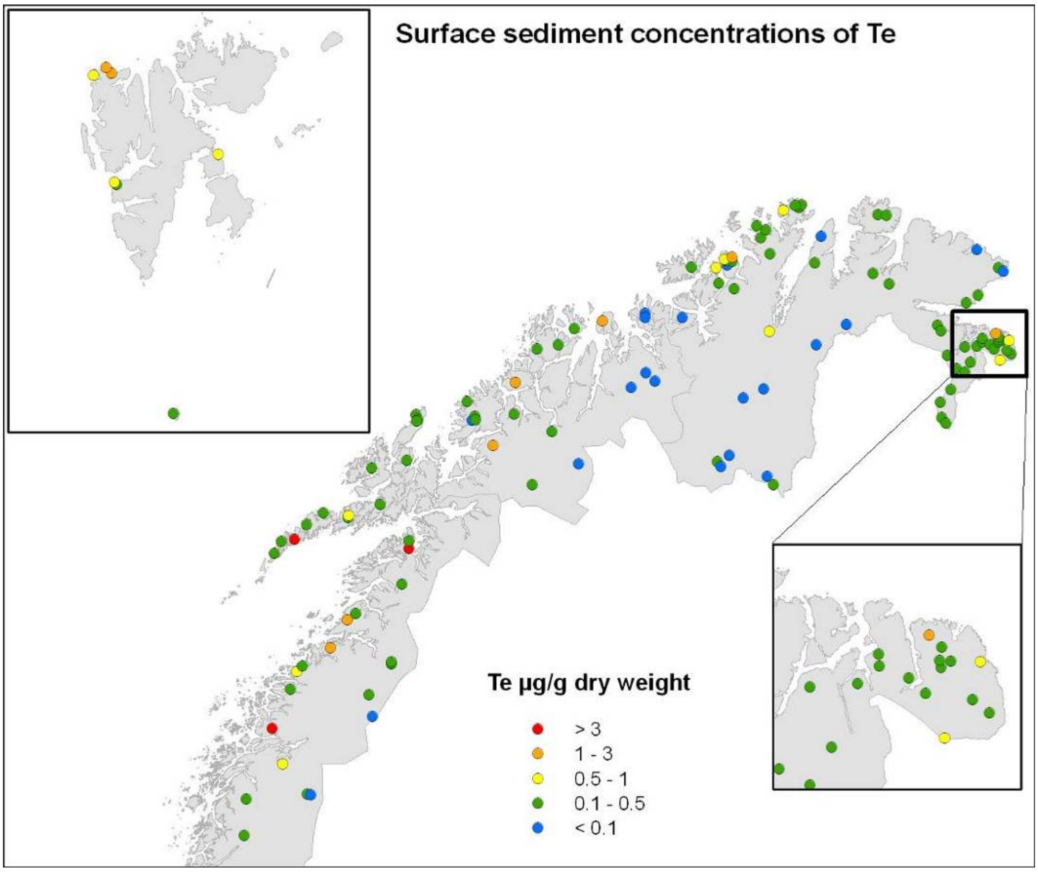


Figure 24. *Concentrations (µg/g dw) of tellurium (Te) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

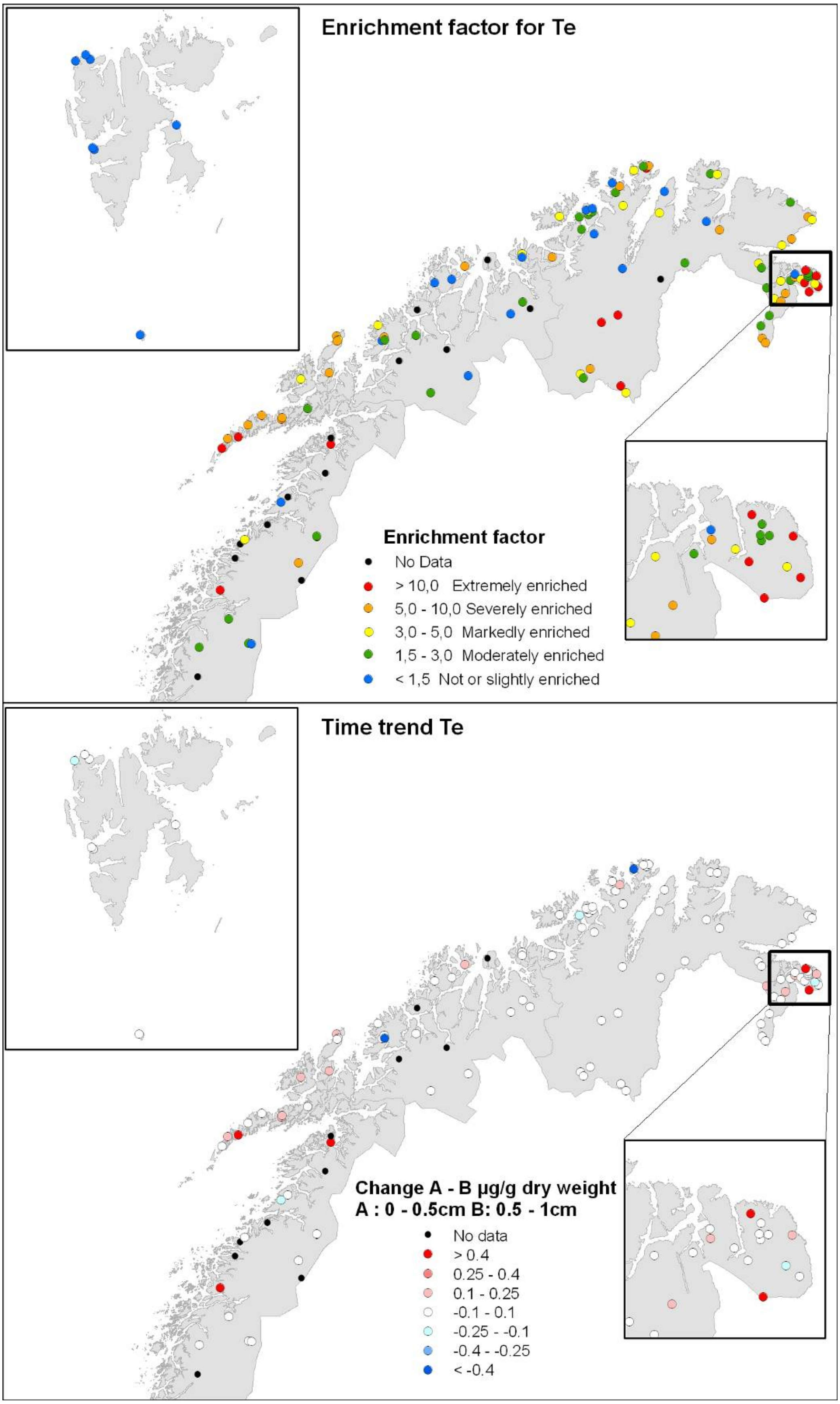


Figure 25. *Enrichment factor for tellurium (Te) in surface sediments (upper figure) and Differences in concentrations (µg/g dw) of Te between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.9 Nickel (Ni)

The highest concentrations of nickel (Ni) in surface sediments were recorded in the lakes in eastern Finnmark on the Sør-Varanger Peninsula (*Figure 26*). The concentrations in the 14 lakes in this area ranged from 61.2 - 456.1 µg/g dw, with an average concentration of 143.4 µg/g dw. The median value for all the lakes in this study was 30.3 µg/g dw. Elevated levels were also measured in lakes along the coast of Troms and Finnmark County. The lowest concentrations were observed in the lakes in Lofoten / Vesterålen in Nordland County and in the inner part of Finnmark County. The levels in the lakes on Svalbard ranged from 12.6 to 52.1 µg/g dw. The levels of nickel in the sediments in Lake Ellasjøen are elevated. In a recent study from this lake, Evenset *et al.* (2007a) studied time trends of heavy metal in the sediment. They indicated that the recorded levels of Ni in the lake had been affected by emissions from the smelters in Northwest Russia (Nikel and Zapolyarny) since the time trends in the concentration of Ni follow the same trends as the emissions from the smelter.

Most of the lakes in this study can be categorised as slightly to moderately enriched with nickel (*Figure 27*). However many of the lakes in the eastern part of Finnmark County are categorised as severely to extremely enriched.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals a severe increase in the concentrations of nickel in sediments in the eastern part of Finnmark (*Figure 27*). The reason for this is increased emissions of Ni from the smelters in Nikel, Russia. Studies performed on water chemistry and air pollutants in the area confirm the same pattern with increasing levels of nickel over the last five years (Skjelkvåle *et al.* 2008). In other regions the pattern is not clear. In some lakes the levels decrease while the levels increase in others. The concentration of Ni in the lakes on Svalbard seems to be unchanged or slightly decreasing.

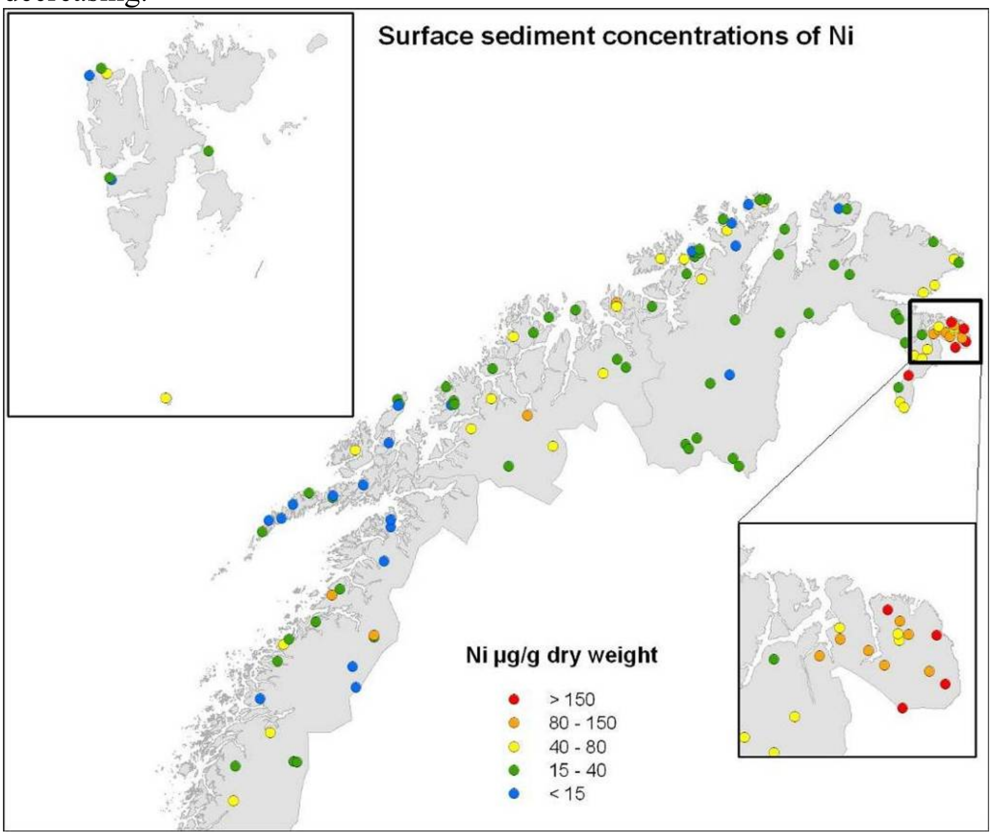


Figure 26. *Concentrations (µg/g dw) of nickel (Ni) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

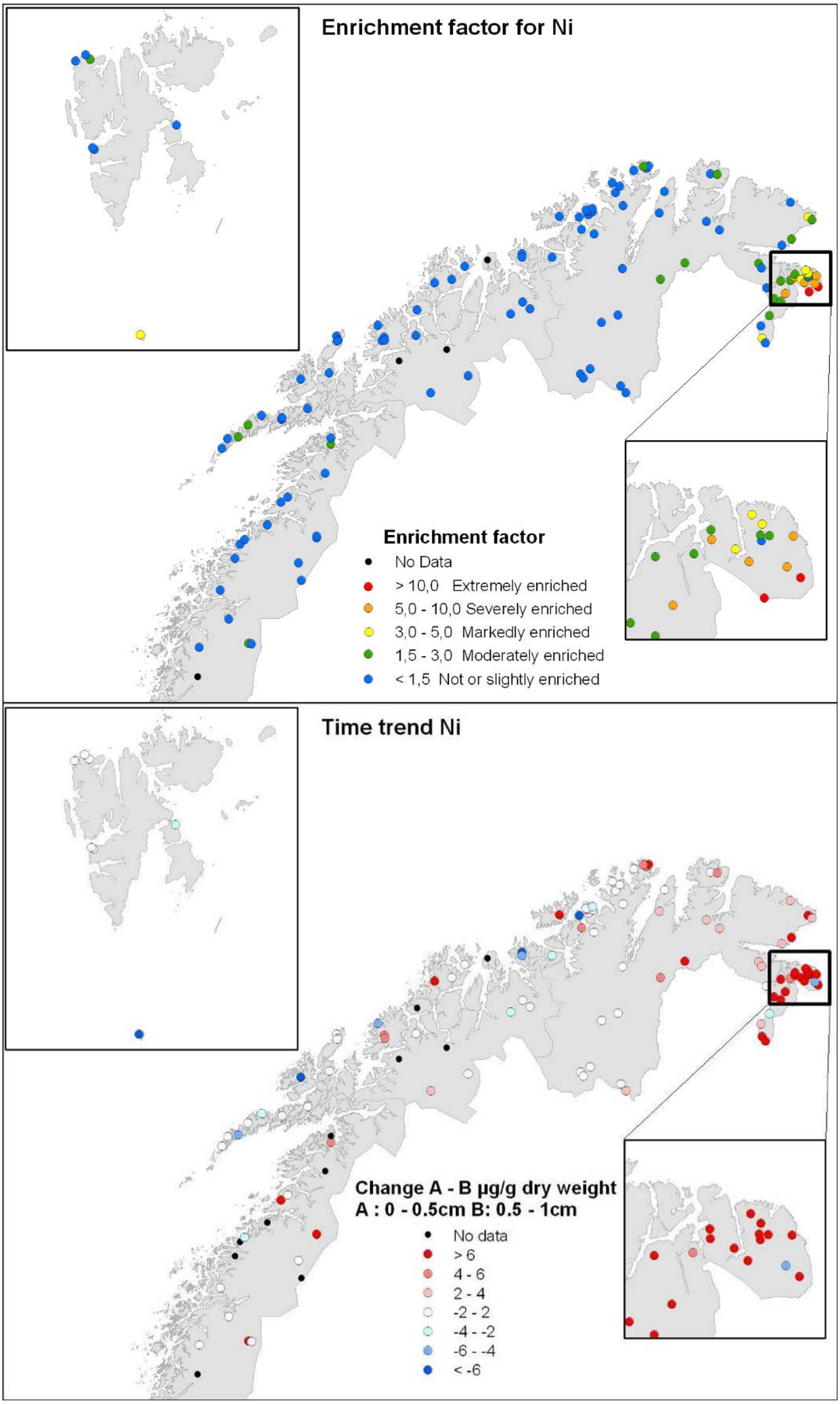


Figure 27. *Enrichment factor for nickel (Ni) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Ni between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.10 Copper (Cu)

The concentrations of copper (Cu) in surface sediment were below 70 µg/g dw in the major part of the region (blue dot in *Figure 28*). The median level for all the lakes in this study was 46.2 µg/g dw. However higher levels were observed in the coastal lakes in Troms County and especially in eastern Finnmark (levels up to 346 µg/g dw). The reason for the elevated levels in Troms is due to geochemical conditions in the bedrock (equally levels in reference sediment). The higher levels measured in the eastern part of Finnmark are caused by emissions from the smelter industry in Nikel, Russia.

Almost all the lakes in the region are categorised as slightly enriched with copper, except some of the lakes in eastern Finnmark which are categorised as markedly to extremely enriched (*Figure 29*).

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals that there have been small changes in the Cu concentrations during the last decades (*Figure 29*). However, there has been a quite high increase in the levels of Cu in the sediments in the lakes in eastern Finnmark. The reason for this is increased emissions from the smelters in Nikel, Russia.

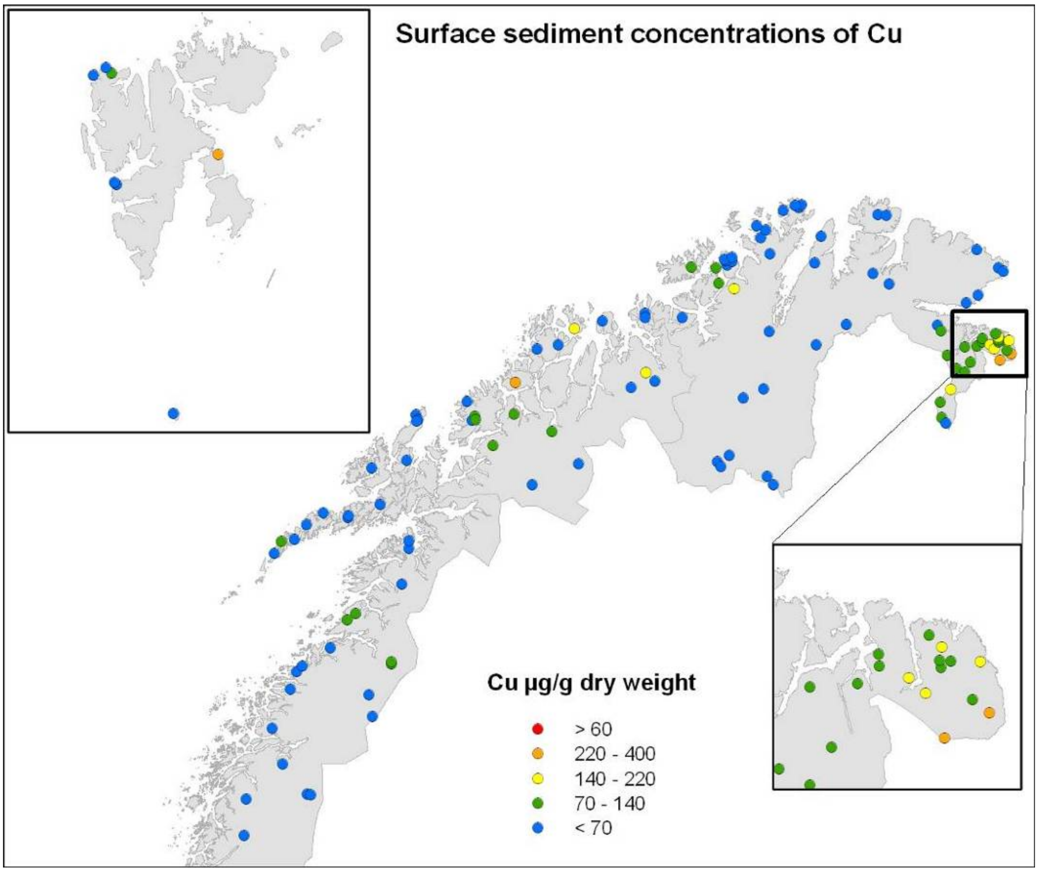


Figure 28. *Concentrations (µg/g dw) of copper (Cu) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

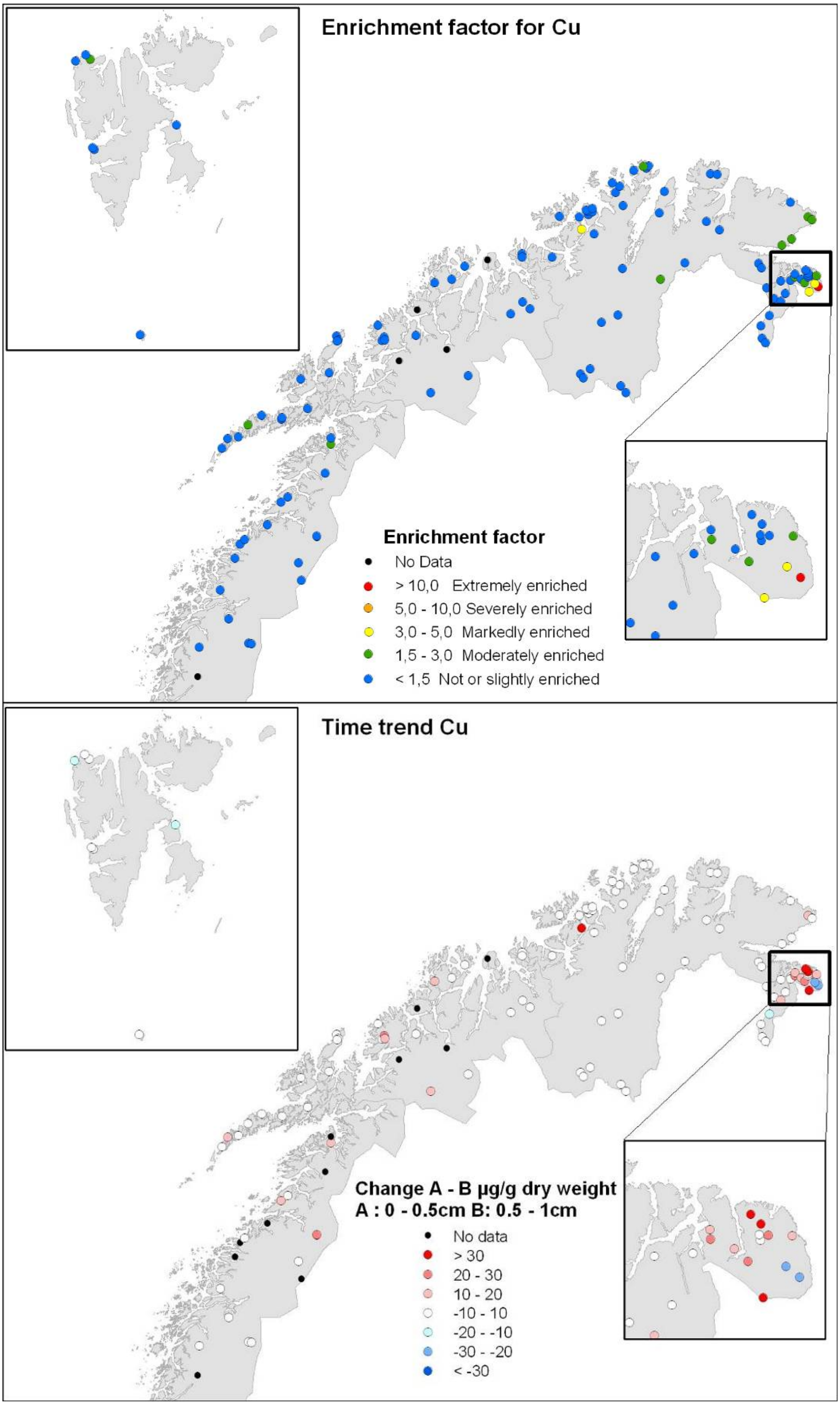


Figure 29. *Enrichment factor for copper (Cu) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Cu between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.11 Selenium (Se)

The highest levels of selenium (Se) in surface sediment were recorded in lakes along the coast and in eastern Finnmark (*Figure 30*). The general picture indicates that long range atmospheric transport is one important source. However the reference sediments reveal that also selenium from the ocean are contributing to the regional pattern with the highest levels along the coast and the lower levels in the inland. The median level in surface sediment for the whole area was 3.6 µg/g dw.

Most of the lakes in this study are slightly to moderately enriched with selenium. However, there are a few lakes that can be categorised as severely or extremely enriched (*Figure 31*).

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), indicates a slight increase in concentrations in the coastal areas in Finnmark (*Figure 31*). There are small changes in the inland lakes and in lakes on Svalbard.

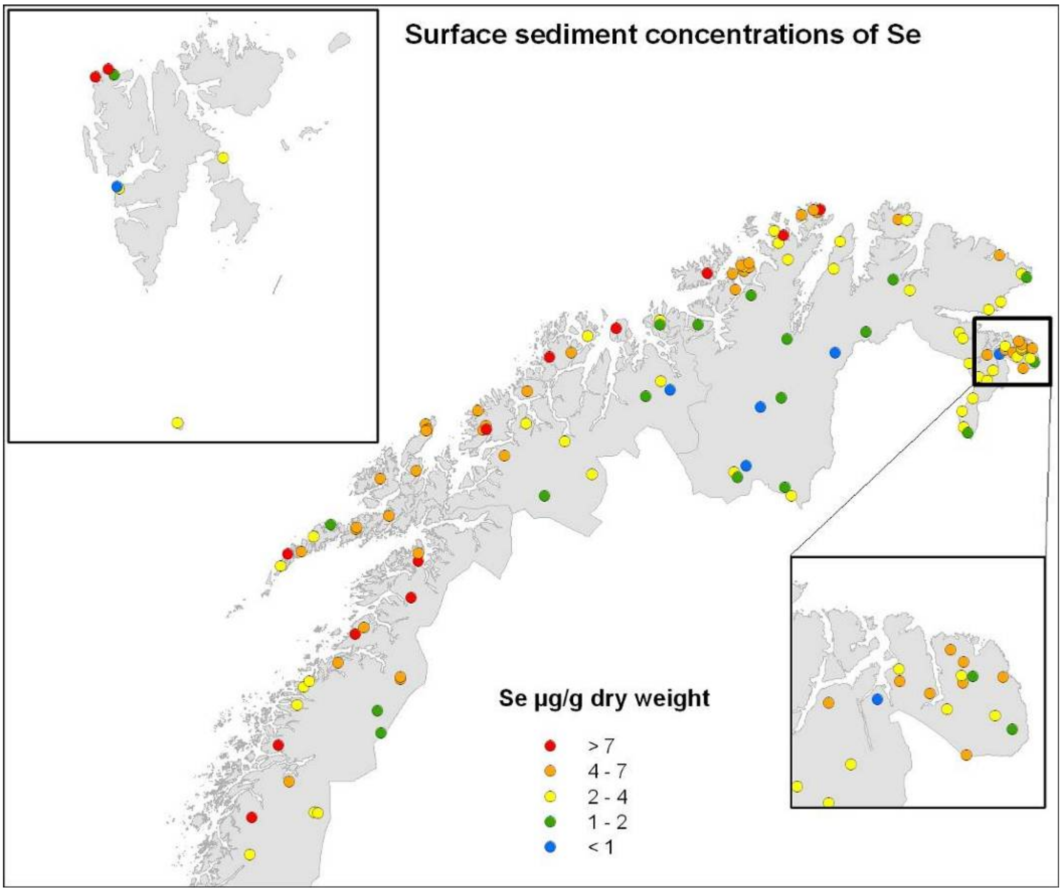


Figure 30. *Concentrations (µg/g dw) of selenium (Se) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

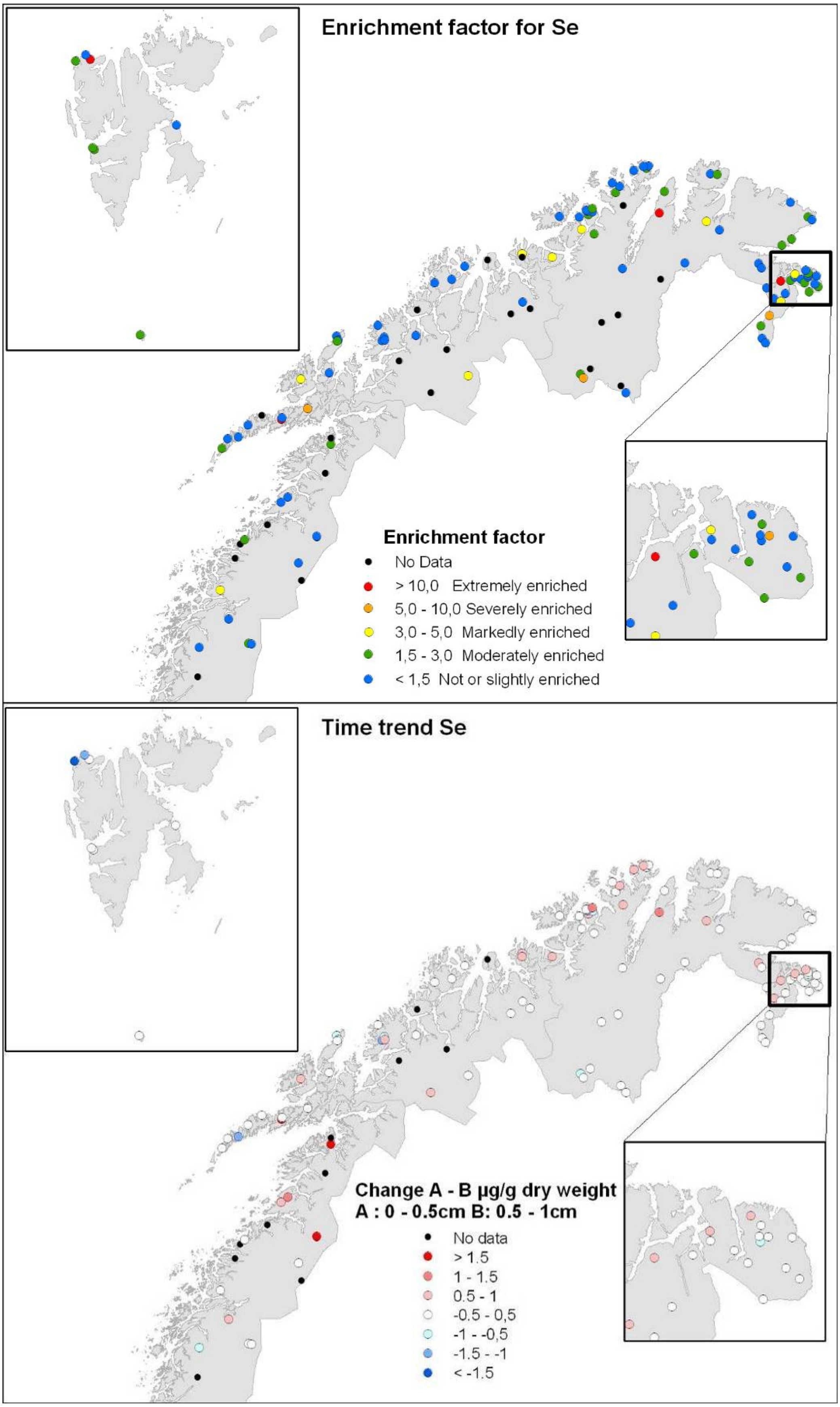


Figure 31. *Enrichment factor for selenium (Se) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Se between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.12 Cobalt (Co)

The concentrations of cobalt (Co) in surface sediments were clearly highest along the coast and in eastern Finnmark (*Figure 32*). The median levels for all the investigated lakes were 23.3 µg/g dw. The lowest levels were recorded in the inner part of Finnmark County. The levels on Svalbard were generally low, except for Lake Ellasjøen on Bjørnøya (45.2 µg/g dw).

The whole study area was slightly to moderately enriched with cobalt except for some of the lakes in eastern Finnmark that was markedly to extremely enriched with cobalt (*Figure 33)*.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals that there have been small changes in the concentrations in most of the region during the last few decades (*Figure 33*). However, the levels of cobalt have increased in lake sediments in eastern Finnmark. The reason for the high levels, higher enrichment factor and the increasing levels of cobalt in eastern Finnmark are increased emissions from the smelter industry in Nikel, Russia.

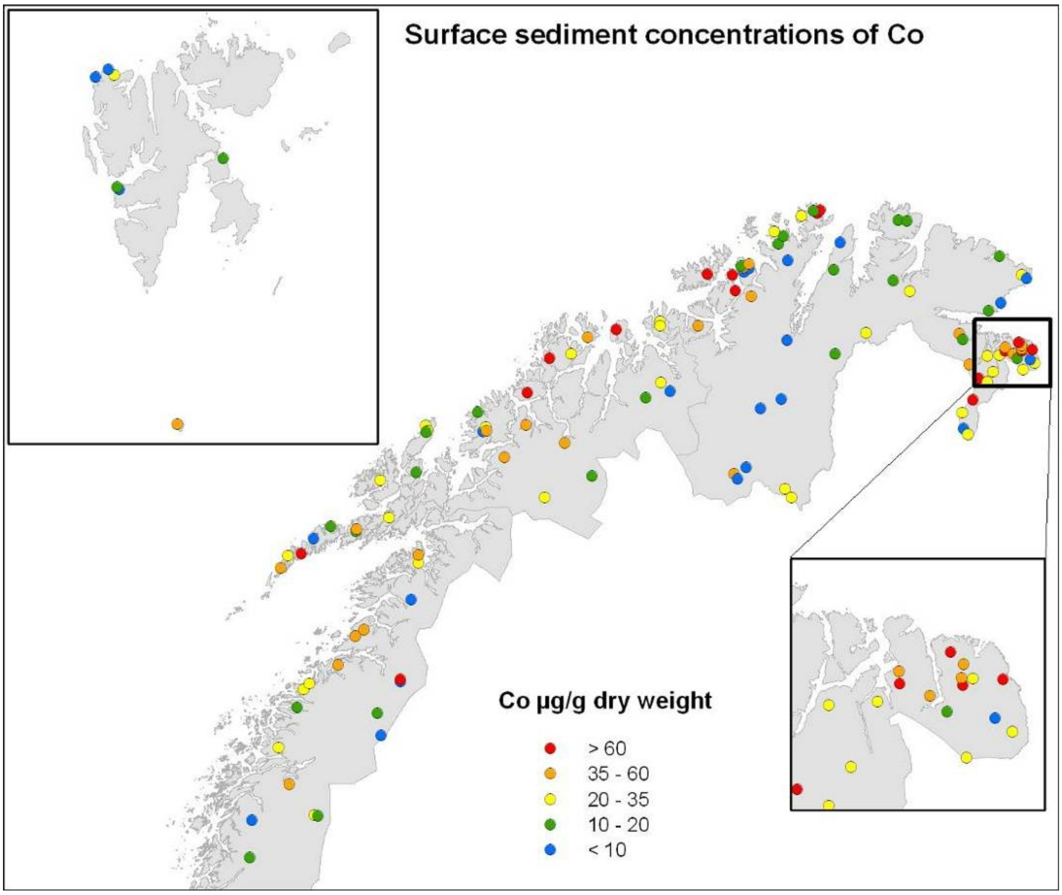


Figure 32. *Concentrations (µg/g dw) of cobalt (Co) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

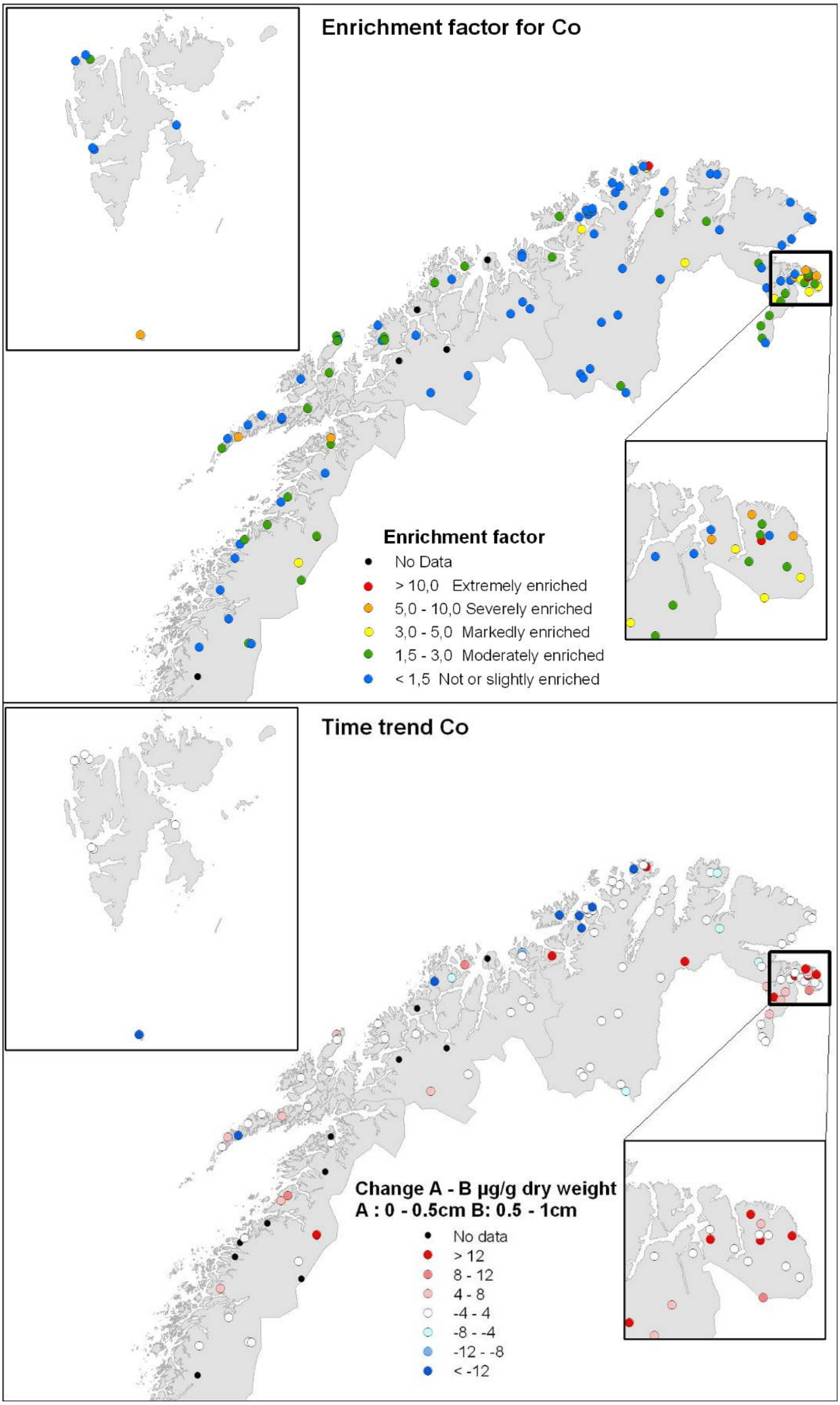


Figure 33. *Enrichment factor for cobalt (Co) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Co between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.13 Thallium (Tl)

The concentrations of thallium (Tl) in surface sediment were generally higher along the coast compared to the lakes in the inland (*Figure 34*). The reason for this is mainly that the content of thallium in the bedrock is higher along the coast. The median value of thallium in surface sediment in the region is 0.43 µg/g dw.

The enrichment factor plot clearly reveals that lake sediments in Northern Norway are only slightly to moderately enriched with thallium (*Figure 35*). The picture is the same for the lakes on Svalbard.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), indicates that there has been small changes over the last few decades (*Figure 35*). However, there are a few exceptions where the level seems to have increased quite a lot. There have been no recent changes in the lakes on Svalbard.

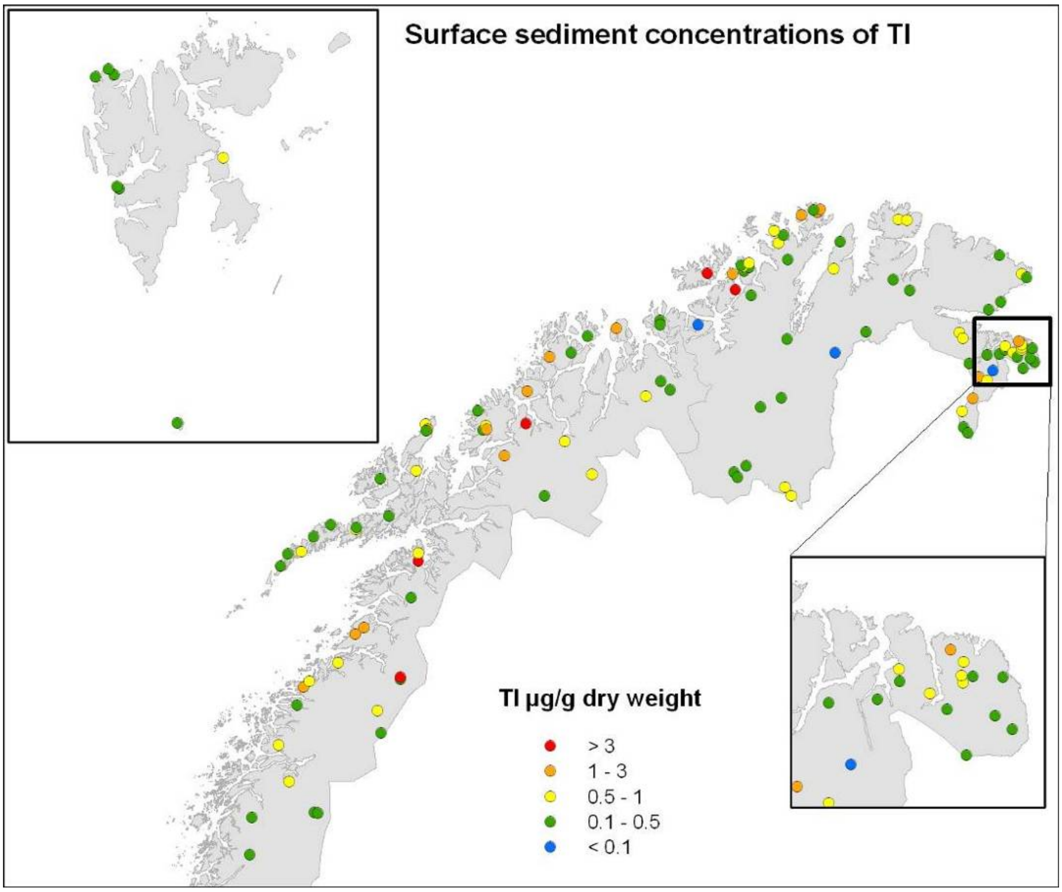


Figure 34. *Concentrations (µg/g dw) of thallium (Tl) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

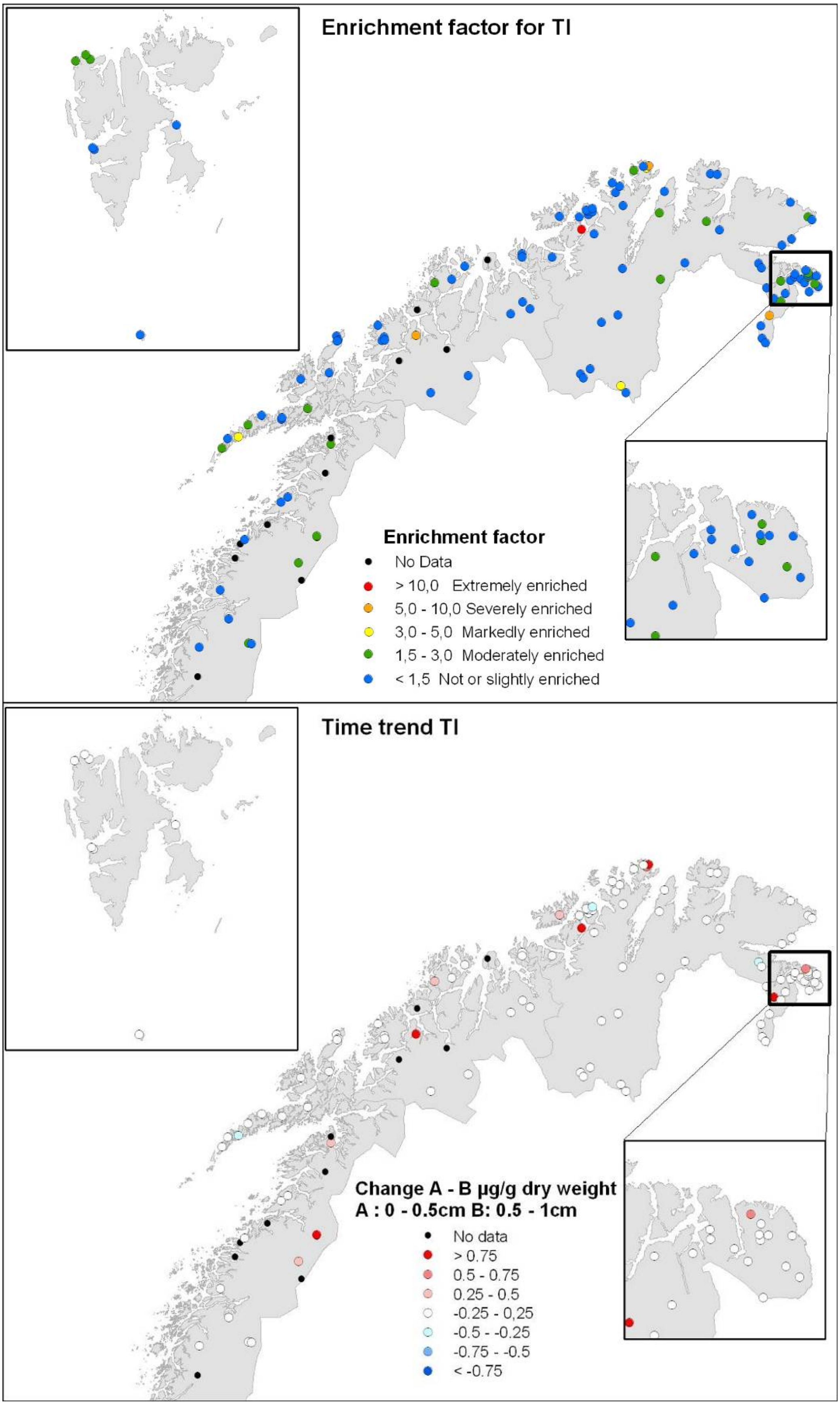


Figure 35. *Enrichment factor for thallium (Tl) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Tl between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.14 Silver (Ag)

The concentrations of silver (Ag) in surface sediment are generally low in the whole region (*Figure 36*). The highest levels are recorded in the coastal areas, due to higher silver content in the bedrock. The levels on Svalbard are low.

Almost all of the lakes are categorised to be slightly to moderately enriched with Ag (*Figure 37*). It seems that the lakes in the inland of Finnmark are slightly more enriched than the lakes along the coast.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), indicates an increase in concentrations in the lakes situated in most of Finnmark County (*Figure 37*). However, there seems to have been no changes in the concentrations for the lakes in eastern Finnmark.

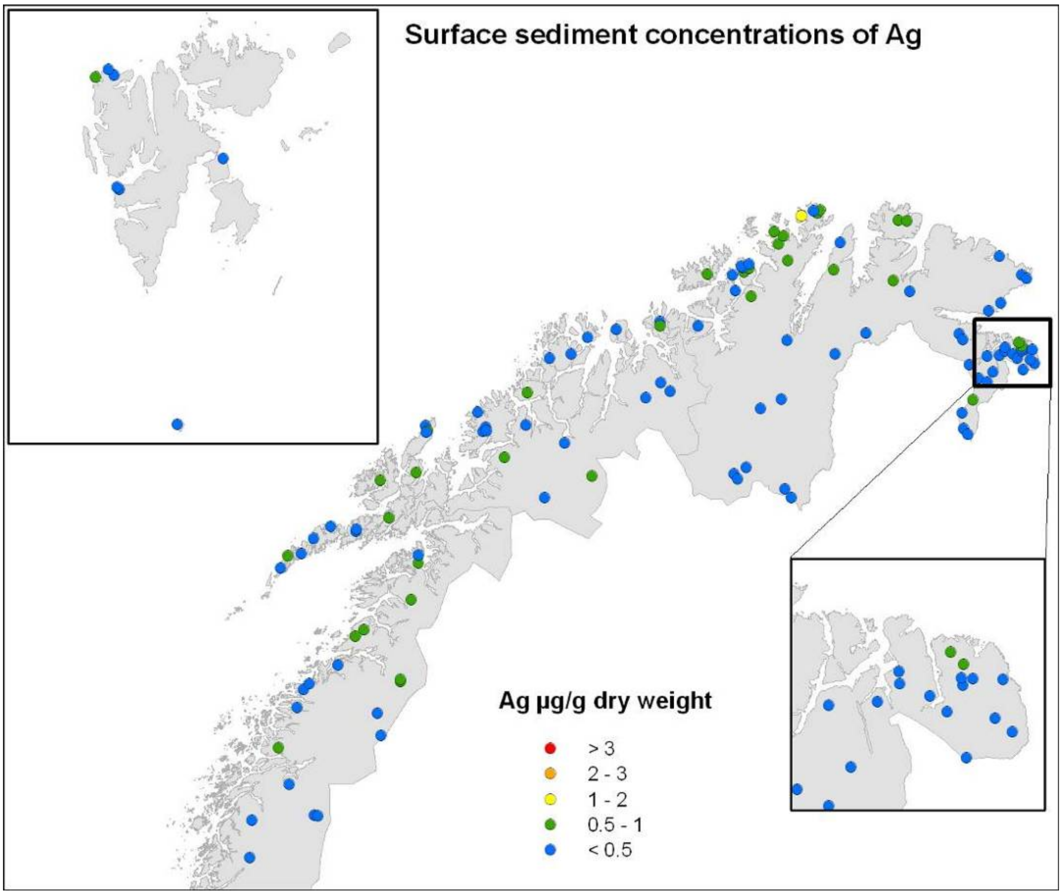


Figure 36. *Concentrations (µg/g dw) of silver (Ag) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

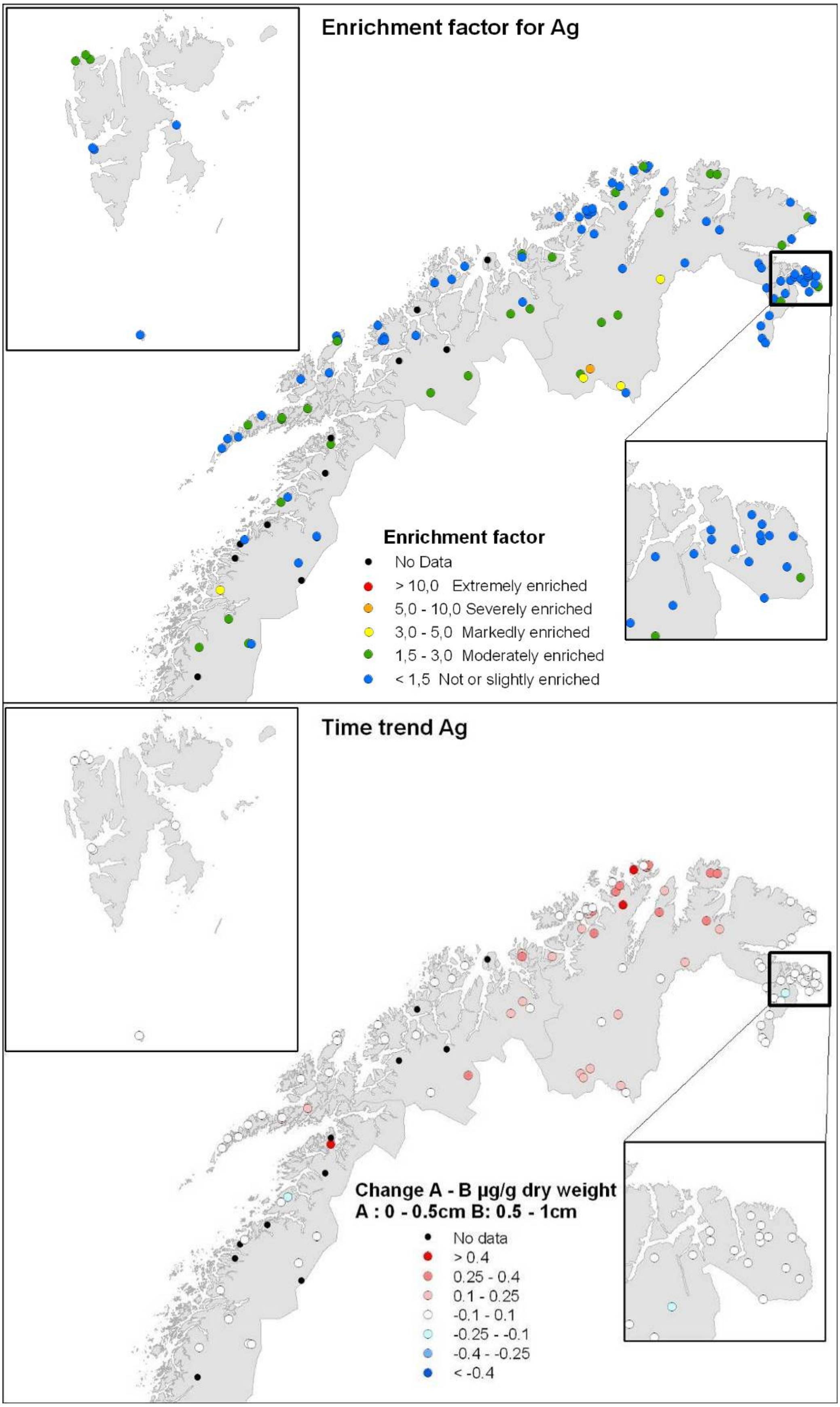


Figure 37. *Enrichment factor for silver (Ag) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of silver (Ag) between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.15 Vanadium (V)

The level of vanadium (V) in surface sediments varies and there is no regional pattern (*Figure 38*). However, the levels in lakes along the coast are somewhat higher than the levels in the lakes in the inland. This is due to a generally higher content of V in the bedrock along the coast. The median V concentration for the lakes in this study is 47.6 µg/g dw. The concentrations in the whole region are comparable with the levels that have been recorded in lakes from the southern part of Norway.

It seems to have been very little enrichment of V in the region, including Svalbard and most of the lakes are categorised as not or slightly enriched (*Figure 39*).

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals that there have been no major changes in the levels for the last few decades (*Figure 39*). However, it seems to have been a slight increase in some of the lakes in Finnmark. There have been no changes in the lakes on Svalbard.

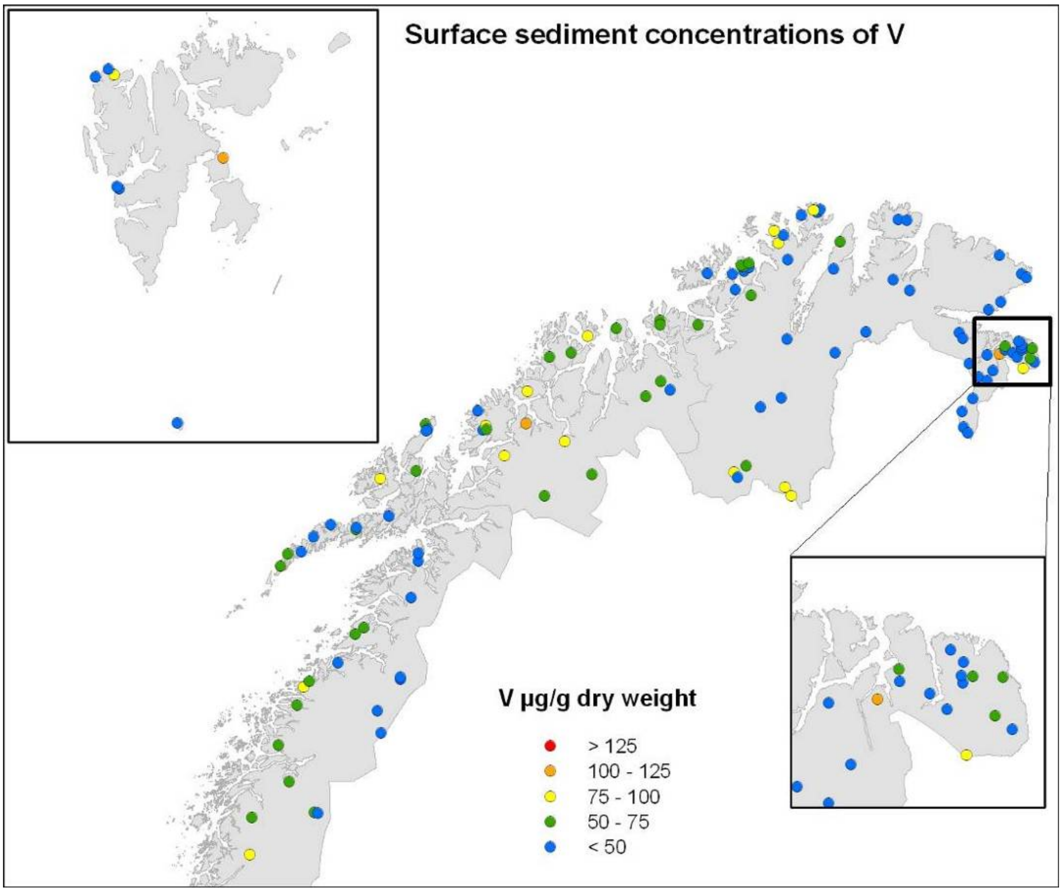


Figure 38. *Concentrations (µg/g dw) of vanadium (V) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

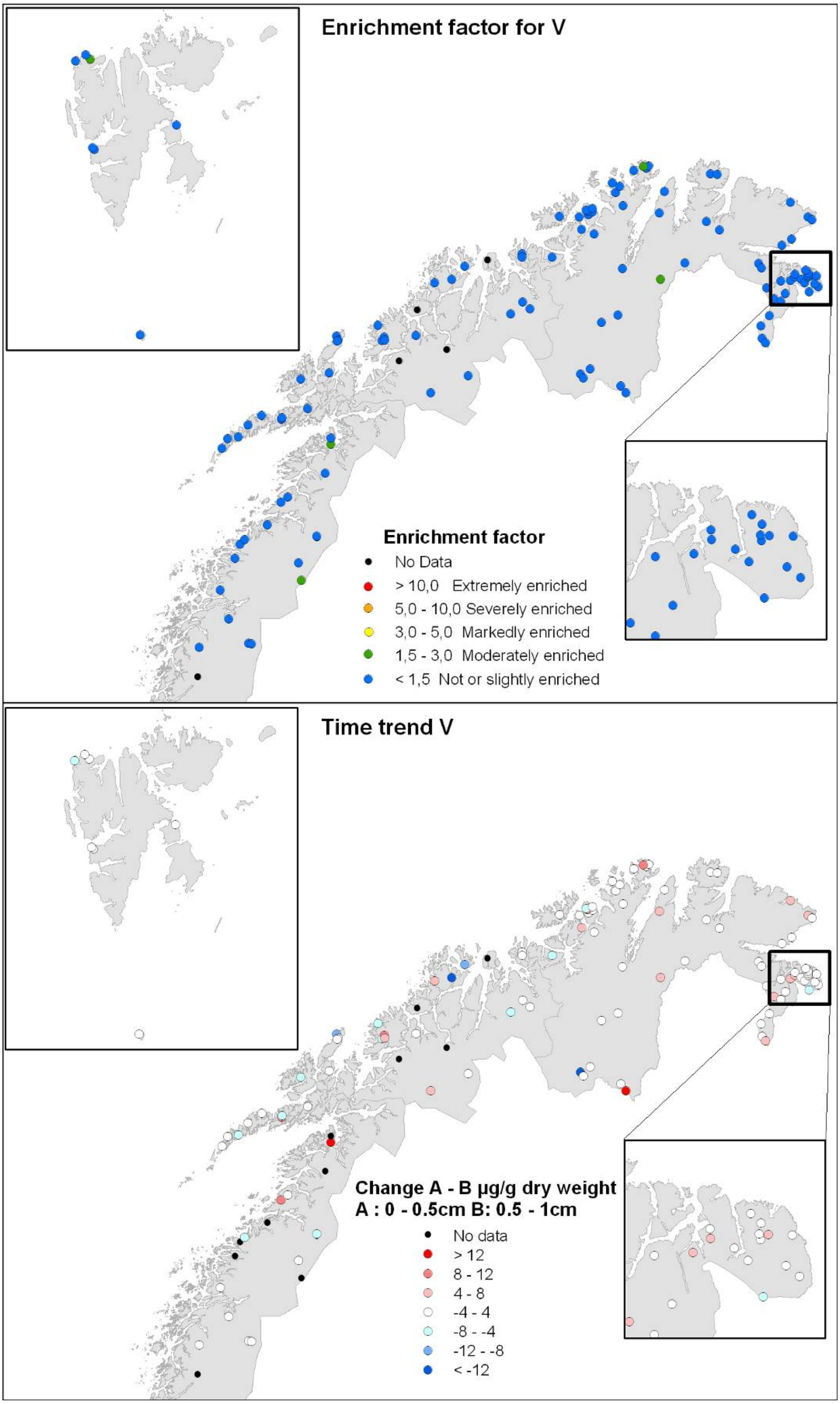


Figure 39. *Enrichment factor for vanadium (V) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of V between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.16 Chromium (Cr)

The concentrations of chromium (Cr) in surface sediments were generally higher along the coast of Troms, the western coast of Finnmark and the eastern Finnmark County than for the other areas (*Figure 40*) due to natural high levels in the bedrock. The median level of chromium for the studied area was 33.4 µg/g dw. The levels on Svalbard were below the median level except for Richardvatn (64.8 µg/g dw) on the north west coast of Svalbard.

The enrichment factor plot indicates that all, except 4 lakes, are categorised as not or slightly enriched with Cr (*Figure 41*).

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), show large variations. However, there seems to have been an increase in levels of chromium in the eastern part of Finnmark (*Figure 41*). This increase can be related to increased emissions from the smelters in Nikel. No recent changes have been observed in the lakes on Svalbard.

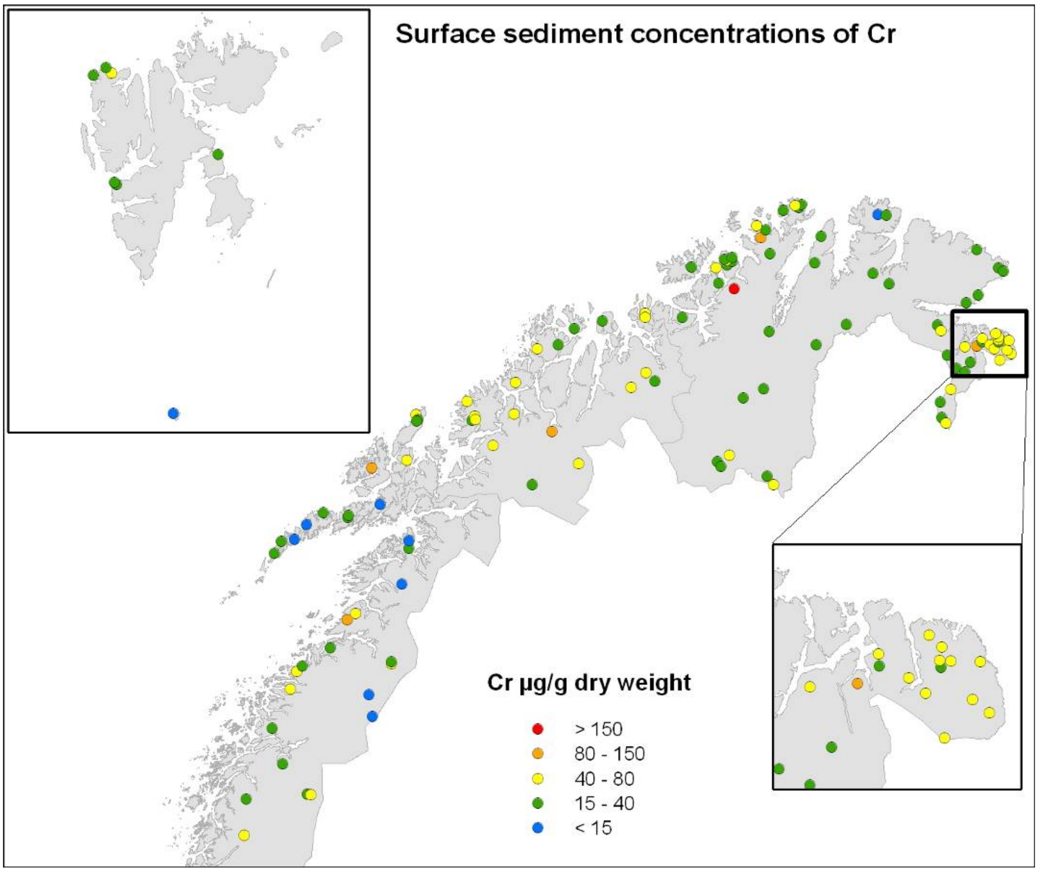


Figure 40. *Concentrations (µg/g dw) of chromium (Cr) in surface sediment from lakes on the mainland of Northern Norway and on Svalbard.*

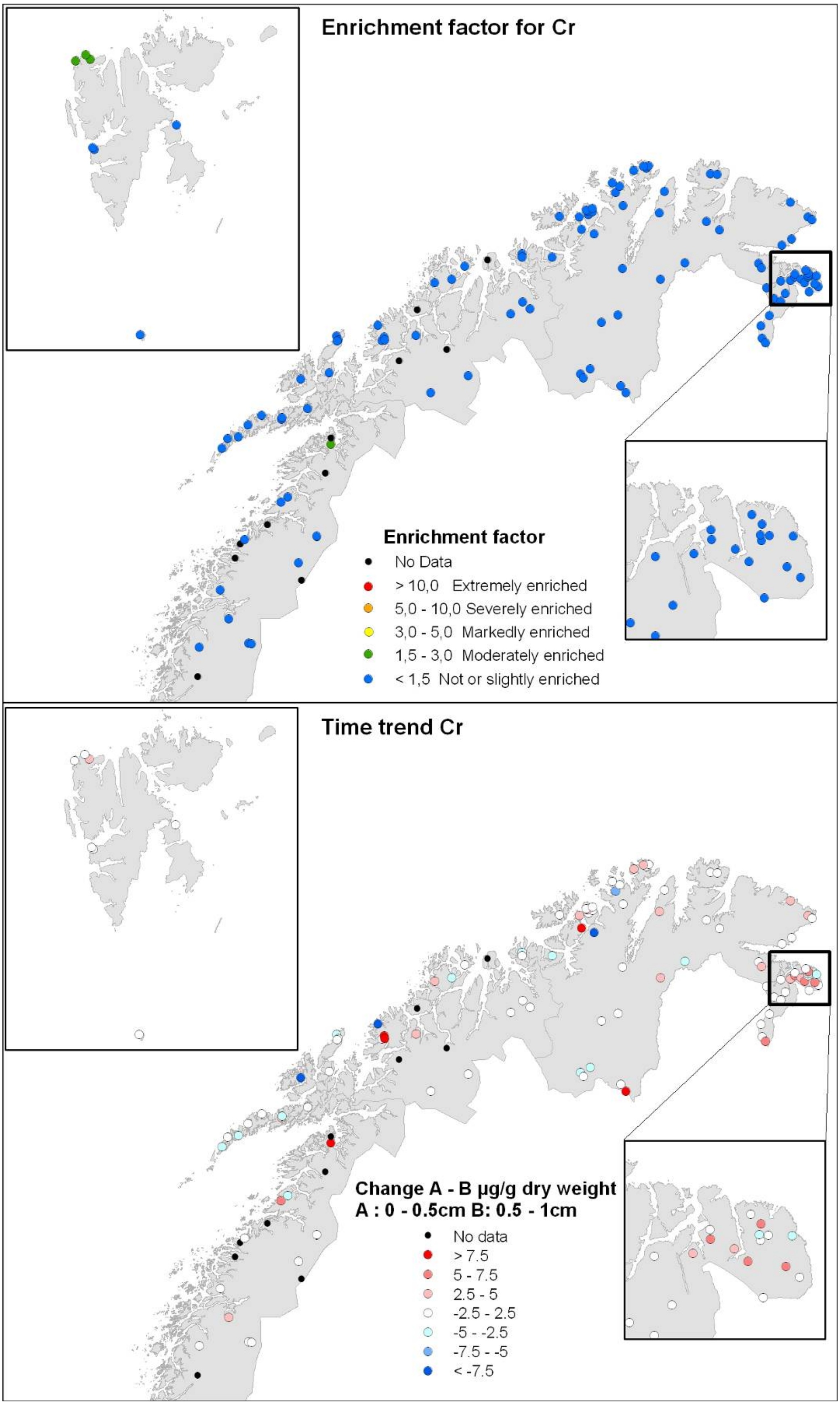


Figure 41. *Enrichment factor for chromium (Cr) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Cr between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.17 Zinc (Zn)

The concentrations of zinc (Zn) in surface sediments were highest along the coast of Nordland and Troms County and in eastern Finnmark (*Figure 42*). The lowest levels were recorded in the inland lakes and in lakes on Svalbard (average 1.69 µg/g dw). The median value of zinc in surface sediments in the whole region was 83.3 µg/g dw.

The lakes in the study can be categorised not or slightly or moderately enriched with zinc (*Figure 43*). This indicates that the higher values along the coast are due to geo chemical condition in the bedrock.

There is not a clear pattern in changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm) (*Figure 43*). There has been an increase in the concentrations in some coastal regions while in other regions concentrations have decreased. In the lakes on Svalbard there have been no changes in the levels over the past decades.

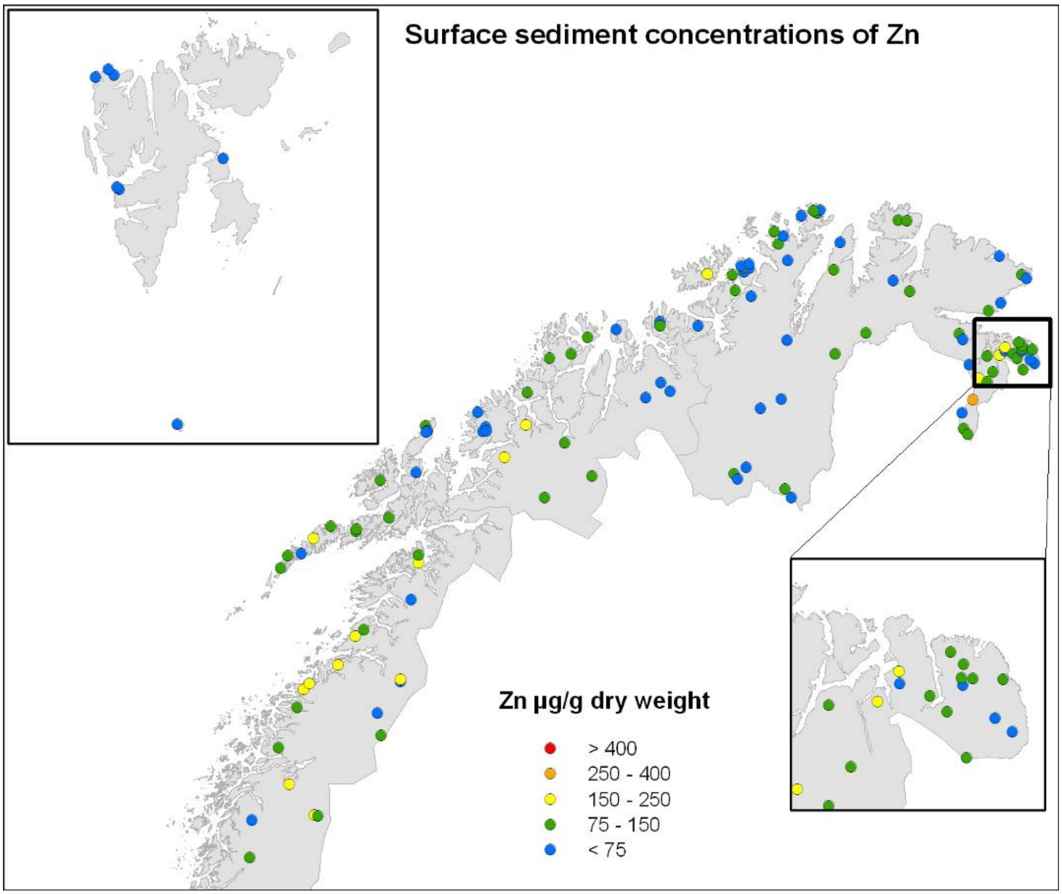


Figure 42. *Concentrations (µg/g dw) of zinc (Zn) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

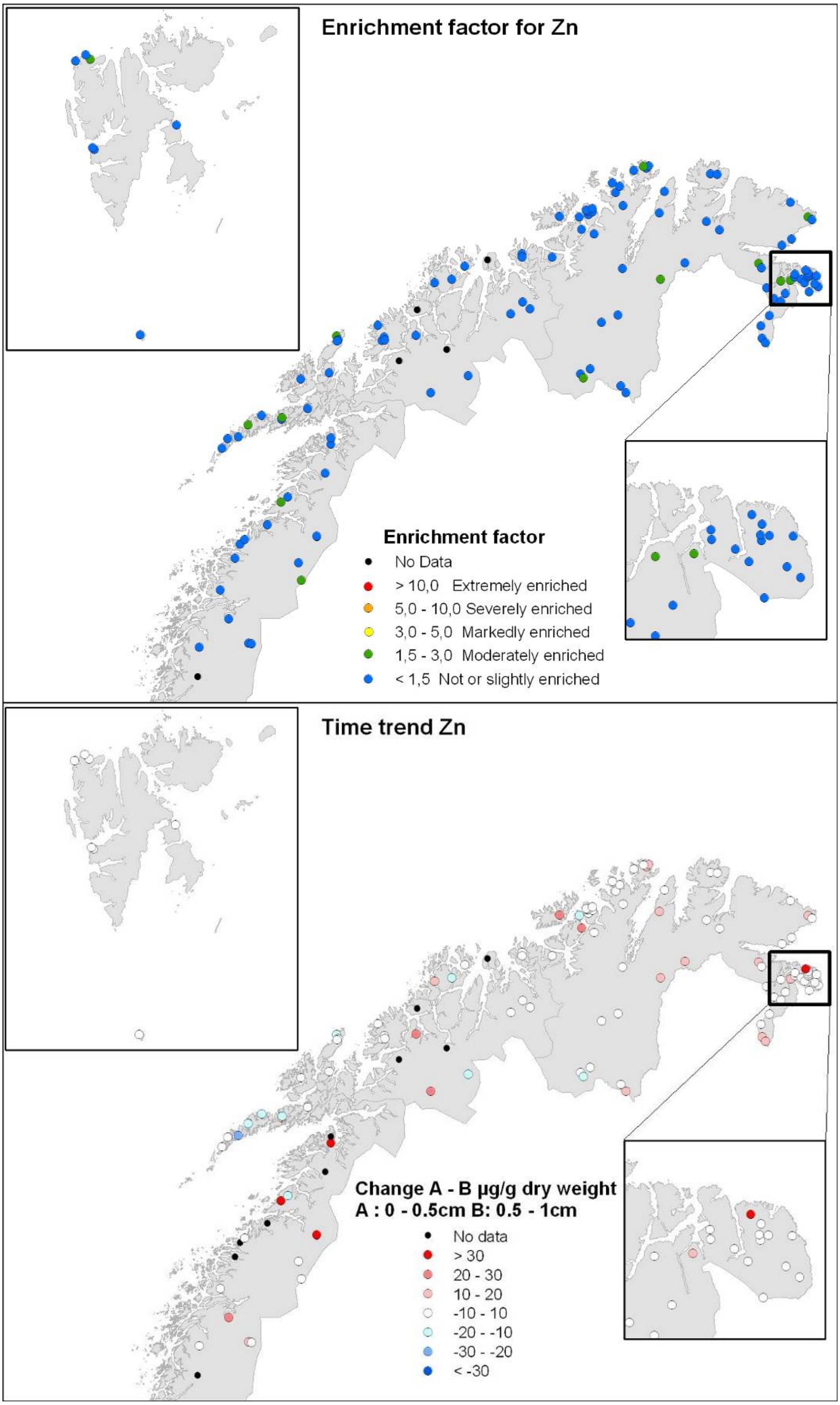


Figure 43. *Enrichment factor for zinc (Zn) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Zn between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.18 Molybdenum (Mo)

The concentrations of molybdenum (Mo) were very similar in surface sediments and in the reference sediment for the whole area (median value 5.9 µg/g dw) (*Figure 44*). No clear regional trends in concentration can be observed, except for very low levels in the lakes on Svalbard (mean value 2.78 µg/g dw).

The enrichment factor plot indicates that most of the lakes are only not or slightly to moderately enriched by molybdenum (*Figure 45*). However a few lakes are categorised as extremely enriched.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals that there have been a slight increase in some lakes in recent years (*Figure 45*).

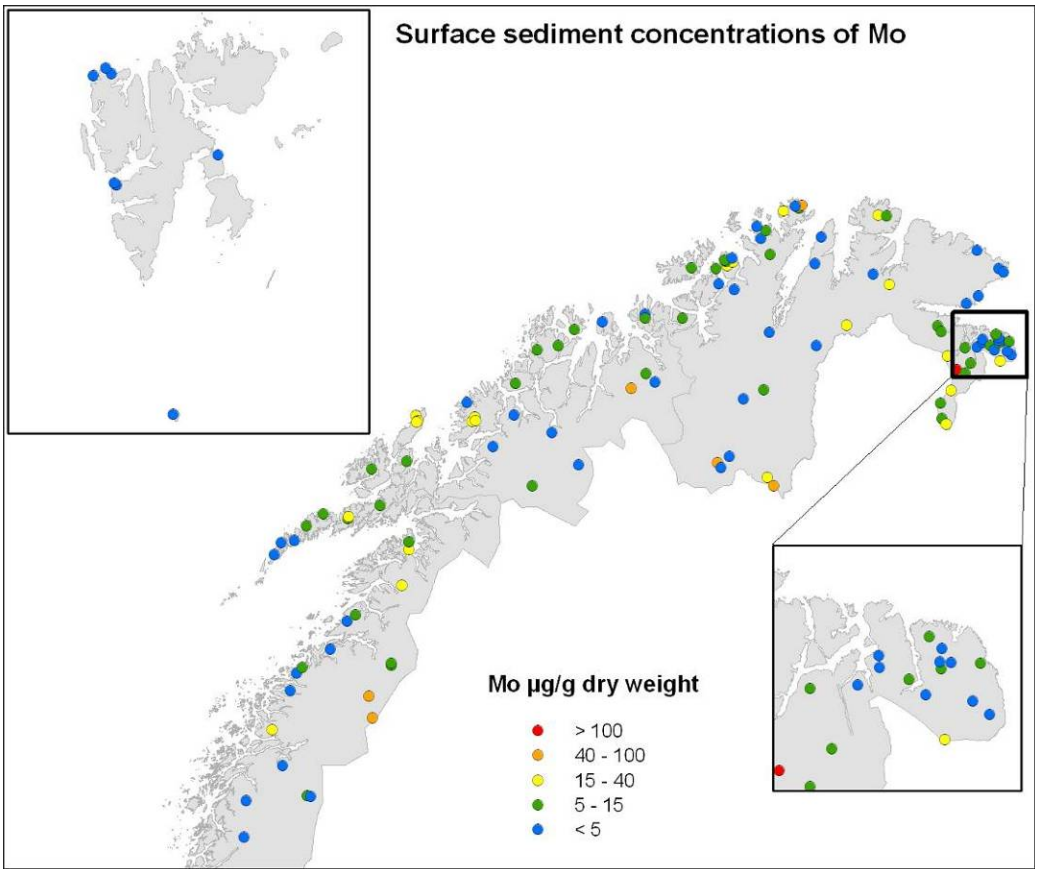


Figure 44. *Concentrations (µg/g dw) of molybdenum (Mo) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

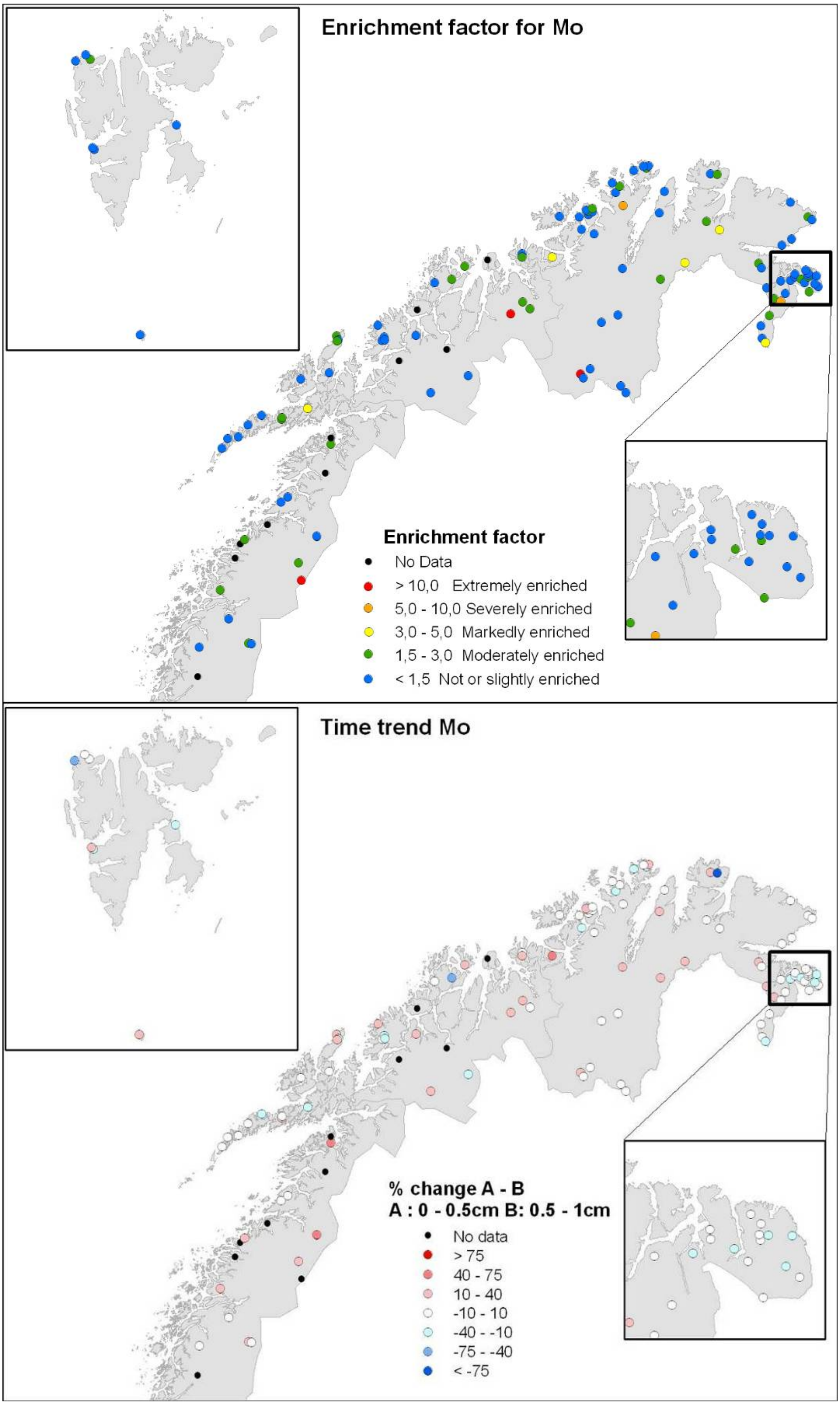


Figure 45. *Enrichment factor for molybdenum (Mo) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of Mo between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.19 Wolfram (W)

The concentrations of wolfram (W) in surface sediments were low in the whole region (median value 0.31 µg/g dw), except in a few scattered lakes (*Figure 46*). The highest level was measured in Lake Arressjøen on Svalbard (4.45 µg/g dw).

All the studied lakes, except for Arressjøen on Svalbard (markedly enriched) were only not or slightly to moderately enriched with wolfram (*Figure 47*). The reason for the high levels in Lake Arressjøen is not clear.

The plot of changes in concentrations in recent time, indicated by the difference between surface sediment (0 - 0.5 cm) and subsurface sediment (0.5 - 1.0 cm), reveals that there have been small changes in the wolfram concentrations in most of the region during the last decades (*Figure 47*).

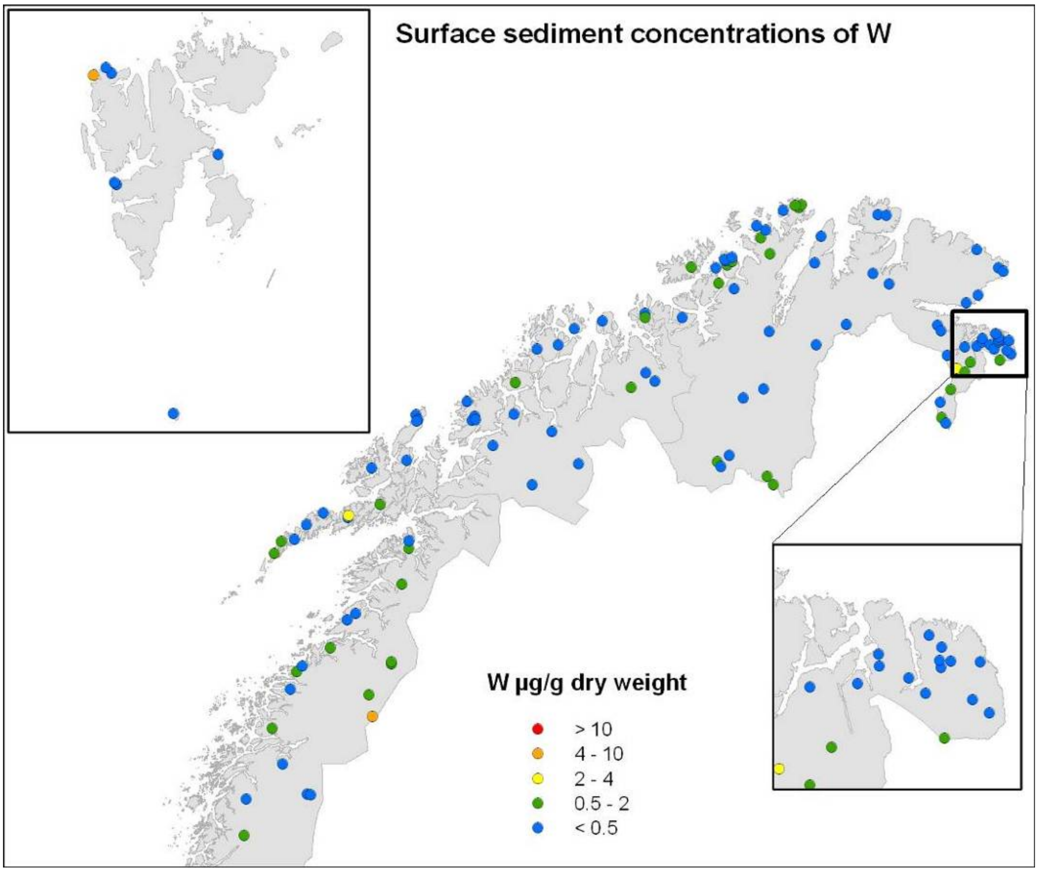


Figure 46. *Concentrations (µg/g dw) of wolfram (W) in surface sediments from lakes on the mainland of Northern Norway and on Svalbard.*

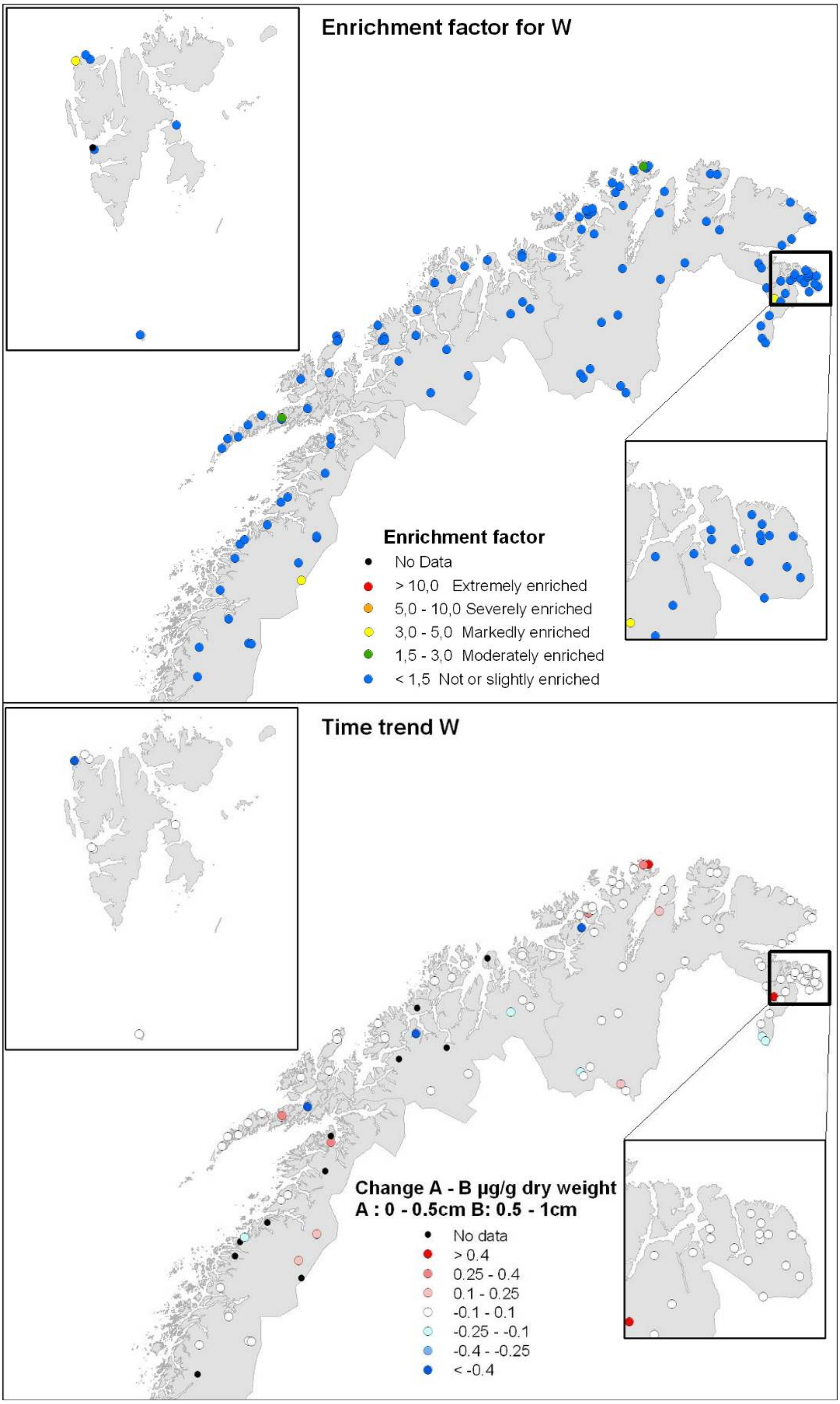


Figure 47. *Enrichment factor for wolfram (W) in surface sediments (upper figure) and differences in concentrations (µg/g dw) of W between surface layer (0 - 0.5 cm) and subsurface layer (0.5 - 1.0 cm) (lower figure).*

6.2.20 Overall assessment of metals

The concentrations of each metal varied between the regions and between each lake. It is important to have in mind that the concentration in lake sediments are largely related to the location of the lake, i.e. the geochemistry in the catchment area (bedrock), the area of the lake and the size of the catchment area, and influence by the ocean. In addition the levels are influenced by other local sources and long range atmospheric transport. A contamination factor,i.e. a ratio between concentrations in the surface sediment and the reference sediment layer, is a good tool in the interpretation of the degree of contamination of each metal. However, this will not say anything about the quantitative number (levels of contaminated metal). Low geochemical levels give a greater chance to detect time trends and observe regional pattern even if the atmospheric pollution is relatively low. With increasing geochemical concentrations the atmospheric deposited pollutants must be higher in order to be able to detect distinct regional pattern in the degree of contamination. To illustrate this we have made an overview that is showing the levels in surface sediment, reference sediment, differences in concentrations between surface and reference sediment and the contamination factor (*Table 4*). The elements in the table are ranged according to concentration in the reference layer.

Table 4. *Concentrations (µg/g dw) of metals in surface sediment, reference sediments, difference in concentrations between surface layer and reference layer and enrichment factor. All values are median values. Metals with enrichment factor above 2 are indicated with shading.*

Element	µg/g dw surface sediment	µg/g dw reference sediment	µg/g dw surface-reference	Enrichment factor	Number of lakes
Sb	0.172	0.022	0.127	6.444	116
Te	0.261	0.055	0.127	3.029	110
Hg	0.151	0.059	0.092	2.614	122
Sn	0.421	0.082	0.187	3.863	110
Bi	0.483	0.105	0.305	3.771	111
W	0.307	0.199	0.057	0.307	122
Ag	0.346	0.308	0.050	1.232	110
Cd	0.585	0.354	0.247	1.806	119
Tl	0.431	0.378	0.046	1.188	110
Se	3.586	2.123	1.061	1.232	110
As	8.963	3.729	4.107	2.625	116
Mo	5.897	5.142	0.520	1.206	111
Pb	45.442	10.080	33.765	4.318	118
Co	23.283	16.726	4.237	1.346	116
Ni	30.300	22.574	0.518	1.028	118
Cr	33.386	39.035	-3.564	0.910	110
V	47.620	50.890	-4.328	0.915	116
Cu	46.158	53.742	-3.276	0.925	116
Zn	83.304	81.360	0.870	1.039	116

The highest contamination factors (K_f) (>2) are registered for Sb, Pb, Sn, Bi, Te, As and Hg. Most of these elements have low concentrations in the reference sediment layer while the elements that have the highest concentrations in the reference layer have the lowest K_f-value. The exception from this pattern are Pb and As, which have high K_f-values, in spite of relative high levels in the reference layer. We know that for Pb the reference layer can be contaminated by pre-industrial discharges (natural bedrock levels in Scandinavia are estimated to 1 – 3 µg/g dw (Lithner and Holm 2003), while the median value in our reference sediment was 10.08 µg/g dw). If the values estimated by Lithner and Holm (2003) are used in the calculation of K_f-values for Pb, the enrichment is considerably higher than what is reflected in the present study. This again indicates that Pb is an important metal when it comes to contamination of lake sediments.

Storvatn (232), Andøya, Nordland County (photo: G. N. Christensen).

6.3 PAH and persistent organic pollutants (POPs) in sediment

6.3.1 Polyaromatic hydrocarbons (PAH)

The PAH concentrations in surface sediments ranged from 17.6 ng/g dw (Lake Cearpmatjavri in Nordland) to 6 615 ng/g dw (Lake Trolldalsvatn in Nordland). An overview of PAH-levels in all the lakes included in the survey is given in *Appendix 3* and *4*. Generally the highest PAH-levels were found in Nordland (*Figure 48*) (average sum PAH-concentration 2 301 ng/g dw), followed by Troms (average sum PAH-concentration 450 ng/g dw), Finnmark (average sum PAH-concentration 469 ng/g dw) and Svalbard (average sum PAH-concentration 67.8 ng/g dw). Generally the highest levels were found in lakes located close to the coast, in areas with a relatively high precipitation rate. The PAH-levels measured in the present investigation were comparable or slightly lower than those measured in the previous AMAP lake survey (Skotvold *et al.* 1997). However, the comparison could only be made for a few lakes that were common to both surveys (16). The numbers of lakes included in the PAH-investigation were 26 in 1995/97 and 75 in 2005/07.

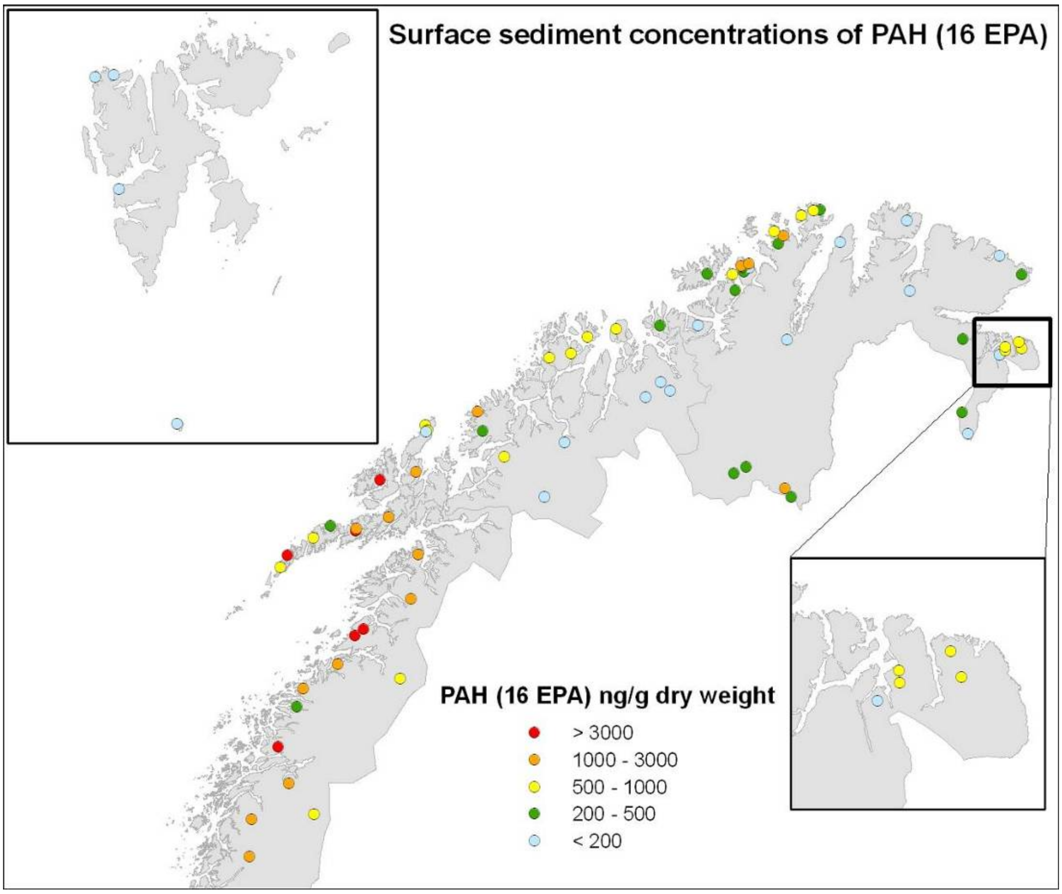


Figure 48. *Map illustrating concentrations of ∑PAH (16 EPA) in surface sediment (0 - 1 cm) from lakes on the mainland of Northern Norwegian and on Svalbard*

6.3.2 Polychlorinated biphenyls (PCBs)

The levels of PCBs were generally low in the surface sediment samples, with a few notable exceptions (*Figure 49*). The lowest levels were measured in lakes from Troms (average $\sum PCB_7 = 1.21$ ng/g dw, n = 7), followed by Finnmark (average $\sum PCB_7 = 2.08$ ng/g dw, n = 24) and Nordland (average $\sum PCB_7 = 2.79$ ng/g dw, n = 18). All the investigated lakes on the mainland of Northern-Norway had $\sum PCB_7$-levels that were below 14.0 ng/g dw. Langvatnet on Seiland, Finnmark, had the highest level of the mainland lakes (13.14 ng/g dw). The highest PCB-levels in the investigation were measured in surface sediments from lakes on Svalbard (average $\sum PCB_7 = 10.16$ ng/g dw, n = 5). All the investigated lakes on Svalbard had elevated PCB-levels (*Figure 49*), but the highest level (24.25 ng/g dw) was found in Lake Ellasjøen on Bjørnøya. This lake is heavily affected by seabirds, and known from previous investigations to have high levels on POPs (Evenset *et al.* 2004; 2005; 2007 a; b). Kongressvatn, which is located in close proximity to the Russian settlement Barentsburg, had the second highest PCB-concentrations measured in the present study (15.79 ng/g dw). Relatively high levels were also measured in Lake Åsøvatn (6.09 ng/g dw), which is another seabird-affected lake far north on Svalbard.

The PCB-levels measured in the present investigation seemed to be slightly lower than those measured in the previous AMAP lake survey (Skotvold *et al.* 1997). The decrease was highest in the lakes with the highest concentrations. For instance Skotvold *et al.* (1997) reported a $\sum PCB_7$ level of 32.7 ng/g dw for Lake Ellasjøen, while the corresponding level measured in the present investigation was 24.25 ng/g dw.

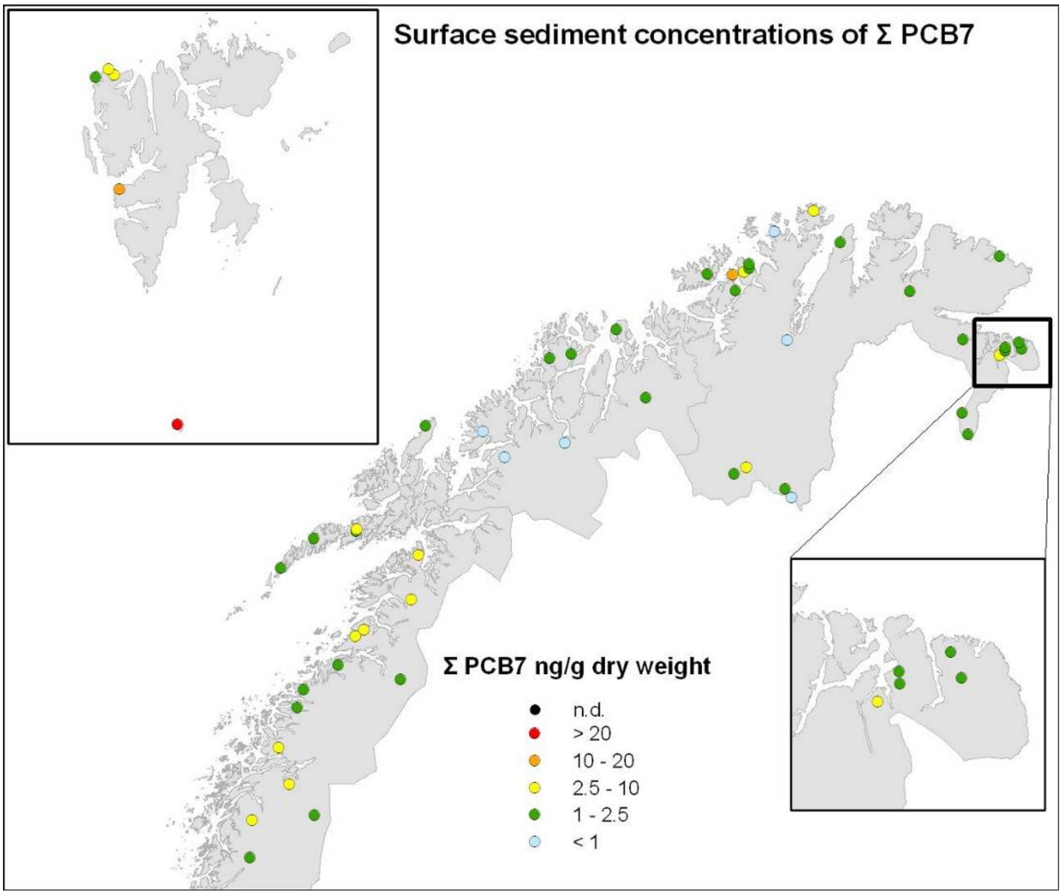


Figure 49. *Map illustrating concentrations of $\sum PCB_7$ (7 "Dutch") in surface sediment (0 - 1 cm) from lakes on the mainland of Northern Norwegian and on Svalbard.*

6.3.3 Chlorinated pesticides

HCB:
Low levels of HCB (from < lod - 2.27 ng/g dw) were measured in surface sediments from all regions (see *Table 5*). The average HCB-concentrations for Nordland, Troms, Finnmark and Svalbard were 0.29, 0.06, 0.33 and 0.57 ng/g dw, respectively. The highest HCB-concentration (2.27 ng/g dw) was measured in surface sediment from Langvatnet on Seiland, Finnmark. The same lake had elevated levels of PCBs (see chapter 6.3.2). Generally, the levels of HCB were considerably lower in the present investigation than in the study of Skotvold *et al.* (1997).

Table 5. *Levels of PCBs and chlorinated pesticides in surface sediments from lakes on the mainland of Northern-Norway and Svalbard. The location of the lakes is shown in Figure 1. All concentrations are given in ng/g dw. n.d. = not detected. Endrine was also measured, but levels were below level of detection (lod) in all samples.*

Name	Lake no.	$\sum PCB_7$[a]	Tot PCB	HCB	∑DDT[b]	∑HCH[c]	∑chlord[d].	Tox[e]	Dieldr.	Mirex
Elgviddvatnet	194	2.09		-	-	-	-	-	-	-
Øvre Sørvatn	195	4.29		-	-	-	-	-	-	-
Krokvatnet	196	2.87		-	-	-	-	-	-	-
Skittreskvatnet	197	1.63		-	-	-	-	-	-	-
Gråvatnet	199	7.76		-	-	-	-	-	-	-
Grønåsvatnet	202	1.64		-	-	-	-	-	-	-
Markavatnet	204	1.97		-	-	-	-	-	-	-
Fiskeløysvatnet	208	1.09		-	-	-	-	-	-	-
Valnesvatnet	210	1.33	210	0.39	n.d.	n.d.	0.12	114	n.d.	n.d.
Steigtindvatnet	211	4.08		-	-	-	-	-	-	-
Trolltindvatnet	213	2.79		-	-	-	-	-	-	-
Tennvatn	215	5.37		-	-	-	-	-	-	-
Kilvatnet	219	2.75		-	-	-	-	-	-	-
Vikvatnet	224	1.53	2.04	n.d.	0.64	n.d.	n.d.	n.d.	n.d.	n.d.
Strumpvatnet	226	1.61	2.57	0.26	0.66	n.d.	n.d.	192	n.d.	n.d.
Storvatn	227	3.49	10.1	0.46	0.43	n.d.	n.d.	42.4	n.d.	n.d.
Storvatnet	232	2.04	3.54	0.44	0.89	n.d.	n.d.	86.8	n.d.	0.25
Skøvatnet	235	0.76	2.15	0.21	n.d.	n.d.	n.d.	41.3	n.d.	n.d.
Kapervann	236	0.29	0.55	n.d.	n.d.	n.d.	n.d.	55.3	n.d.	n.d.
Storvatnet	242	0.67	1.51	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
P Sørensensvatn	245	1.09	1.43	n.d.	n.d.	n.d.	n.d.	34.8	n.d.	n.d.
Langfjordvatnet	248	1.70	2.71	0.21	0.32	n.d.	n.d.	107	n.d.	n.d.
Josvatnet	250	1.56	4.08	n.d.	0.35	n.d.	n.d.	n.d.	n.d.	n.d.
Langvatnet	257	2.28	6.92	1.21	2.92	n.d.	n.d.	n.d.	n.d.	n.d.
Langvatnet	258	13.14	35.0	2.27	3.84	n.d.	n.d.	n.d.	n.d.	n.d.
Gukkesjavri	259	2.55	7.28	n.d.	0.50	n.d.	n.d.	38.0	n.d.	n.d.
Dabmutjavri	260	1.80	4.60	n.d.	0.58	n.d.	0.09	n.d.	n.d.	n.d.
Bakketækjavn	261	1.13	2.96	0.66	1.14	n.d.	n.d.	n.d.	n.d.	n.d.
Russvikvatn	269	1.29	2.50	0.11	0.12	n.d.	n.d.	n.d.	n.d.	n.d.
Gålgutjavri	274	1.09	1.72	0.12	0.22	n.d.	n.d.	n.d.	n.d.	0.03
Lavvojavri	279	2.70	3.95	n.d.	0.30	n.d.	n.d.	n.d.	n.d.	n.d.
Avzejavri	280	1.45	1.80	0.15	0.20	n.d.	n.d.	n.d.	n.d.	n.d.
Gavdnjajavri	282	1.54	3.03	0.16	0.42	n.d.	n.d.	n.d.	n.d.	0.38
Ravdojavri	283	0.86	1.53	0.1	0.09	n.d.	n.d.	32.9	n.d.	n.d.
Vuoååojavri	284	1.00	2.09	0.05	0.15	n.d.	0.02	n.d.	n.d.	n.d.
Syltevikvatnet	285	1.05	1.13	0.08	1.00	0.12	n.d.	n.d.	n.d.	0.39

Name	Lake no.	∑PCB$_7$[a]	Tot PCB	HCB	∑DDT[b]	∑HCH[c]	∑chlord.[d]	∑Tox[e]	Dieldr.	Mirex
Råtjern	291	1.01	1.55	0.49	0.38	n.d.	n.d.	232	n.d.	n.d.
Følvatnet	298	2.50	6.11	0.63	0.39	n.d.	n.d.	80.9	n.d.	n.d.
Ødevatnet	300	1.13	1.13	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Andrevatn	301	2.56	5.23	0.34	n.d.	n.d.	n.d.	21.4	n.d.	n.d.
Langvatnet	302	1.67	3.59	0.27	0.09	n.d.	n.d.	74.5	n.d.	0.05
L. Ropelvvatnet	303	1.34	3.06	0.33	n.d.	n.d.	n.d.	61.5	n.d.	n.d.
Langvatnet	312	1.31	3.07	0.14	n.d.	n.d.	n.d.	53.1	n.d.	0.07
Coalbmejavri	316	1.83	4.09	0.31	0.20	n.d.	0.07	108	n.d.	0.17
Kjeftavatn	319	2.51	3.52	0.24	n.d.	n.d.	n.d.	46.7	n.d.	n.d.
Hestevatn	320	0.80	1.73	n.d.	n.d.	n.d.	n.d.	71.1	n.d.	n.d.
Storvikvatn	323	1.46	5.66	0.24	0.13	n.d.	n.d.	10.9	n.d.	n.d.
Trolldalsvatnet	325	2.39	4.61	0.19	0.39	n.d.	n.d.	22.5	n.d.	n.d.
Holmvatn	324	1.93	4.79	n.d.	0.60	n.d.	n.d.	n.d.	n.d.	n.d.
Ellasjøen	401	24.3	37.1	0.37	2.90	n.d.	n.d.	40.6	n.d.	0.28
Arressjøen	501	1.86	4.13	0.19	n.d.	n.d.	n.d.	10.6	n.d.	0.11
Kongressvatn	503	15.79	40.6	0.49	0.22	0.40	0.50	5.82	0.10	n.d.
Rickardvatn	505	2.90	5.06	1.18	n.d.	n.d.	n.d.	122	n.d.	n.d.
Åsøvatn	506	6.02	13.0	0.64	0.72	0.27	0.71	n.d.	n.d.	n.d.
Min		0.29	0.55	0.05	0.09	< lod	< lod	< lod	< lod	< lod
Max		24.3	40.6	2.27	3.84	0.40	0.71	232	0.10	0.39
Average		2.95	6.14	0.42	0.72	0.26	0.25	68.2		
Median		1.75	3.53	0.27	0.39	0.27	0.11	53.1		

a Sum of CB 28, 52, 101, 118, 138, 153 and 180
b *o.p'*-DDE+ *p.p'*-DDE + *o.p'*-DDD + *p.p'*-DDD + *o.p'*-DDT + *p.p'*-DDT
c sum of α-, β-, and γ-HCH
d sum of Heptachlor, Heptachlor epoxide, Oxychlordane, *trans*-Chlordane, *cis*-Chlordane, *trans*-Nonachlor, *cis*-Nonachlor
e sum of parlar 26, 50 and 62

DDT:

Also the levels of DDT were generally low (*Figure 50*), with ∑DDT (*o.p'*-DDE+ *p.p'*-DDE + *o.p'*-DDD + *p.p'*-DDD + *o.p'*-DDT + *p.p'*-DDT) ranging from < lod - 3.84 ng/g dw (*Table 5*). The highest concentration was measured in Langvatn on Seiland, Finnmark, in the same lake that had elevated levels of PCBs and HCB. The second highest DDT-levels were measured in sediment from another Langvatn in Finnmark (2.92 ng/g dw) and in Ellasjøen on Bjørnøya (2.90 ng/g dw). The most abundant compound was *p p'*-DDE, indicating that long-range transport is the source. The other DDT-compounds were only present in a few samples.

The levels of DDT were generally somewhat lower than the levels reported by Skotvold *et al.* (1997) in some of the same lakes (16 lakes could be compared), but comparable to levels reported by AMAP (2004).

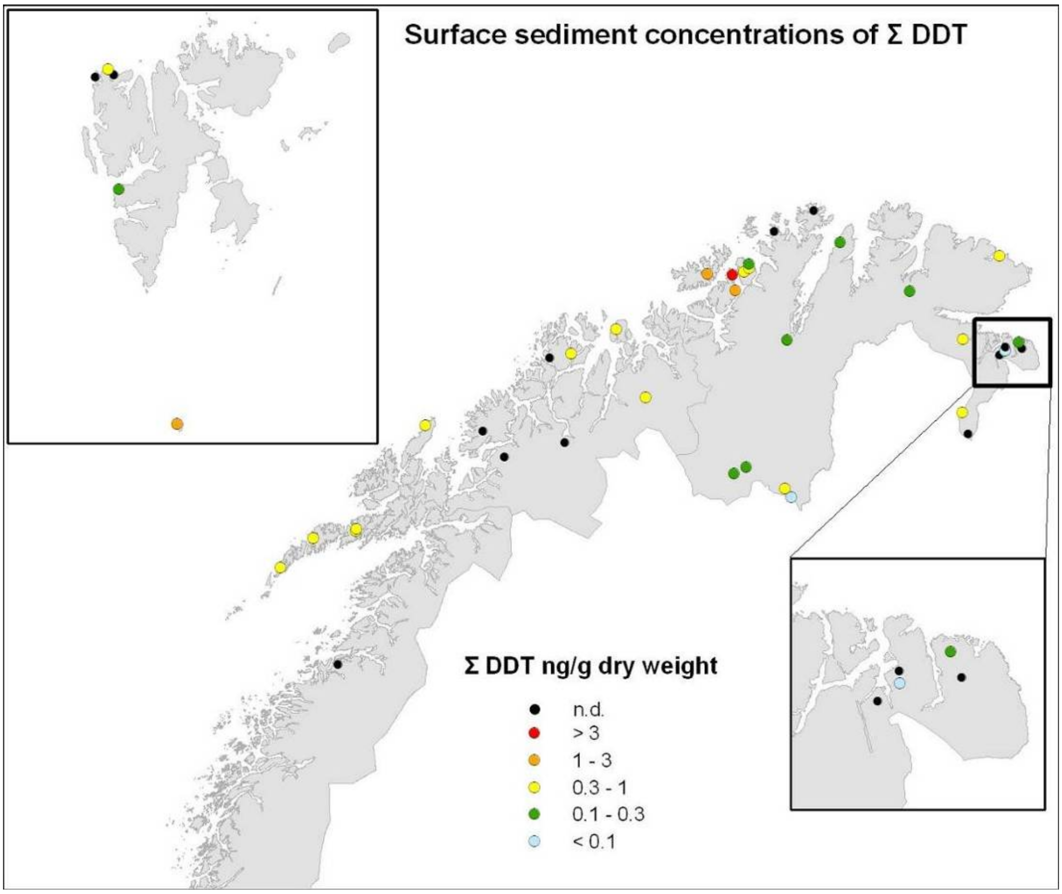


Figure 50. *Map illustrating concentrations of ∑DDT n surface sediment (0 - 1 cm) from lakes on the mainland of Northern Norwegian and on Svalbard.*

HCH (α-, β- and γ-HCH):
HCHs were only detected in sediment from three lakes, of which one is located in Finnmark (Syltevikvatnet) and two on Svalbard (Kongressvatn and Åsøvatn). However, the measured concentrations were low (0.12, 0.40 and 0.27 ng/g dw, respectively) (*Table 5*). Different isomer was measured in the different lakes. In Syltevikvatnet only β-HCH was detected, while the α-isomers were the only one detected in Åsøvatn. In Kongressvatn all three HCH-isomers could be quantified (see *Appendix 4*).

Chlordanes (heptachlor, heptachlor epoxide, oxychlordane, trans-chlordane, cis-Chlordane, trans-Nonachlor, cis-Nonachlor):
Low concentrations of chlordanes (0.02 - 0.71 ng/g dw) were detected in surface sediment from 6 of the 42 lakes that were included in the POP-survey. In the other lakes all chlordane-related compounds were below the detection limits for the analytical method (see Appendix 4). The highest concentrations were measured in Richardvatn (0.51 ng/g dw) and Åsøvatn (0.71 ng/g dw) on Svalbard. Heptachlor, heptachlor epoxide or *cis*-Nonachlor were not detected in any of the samples.

Toxaphene (sum of parlars #26, 50 and 62):
The toxaphene levels were low (<lod (17 lakes) - 0.23 ng/g dw (Råtjern in eastern Finnmark)) (*Figure 51*). Only parlar # 26 and 50 were detected in the sediment samples, with parlar #50 dominating in all the samples were toxaphene were detected.

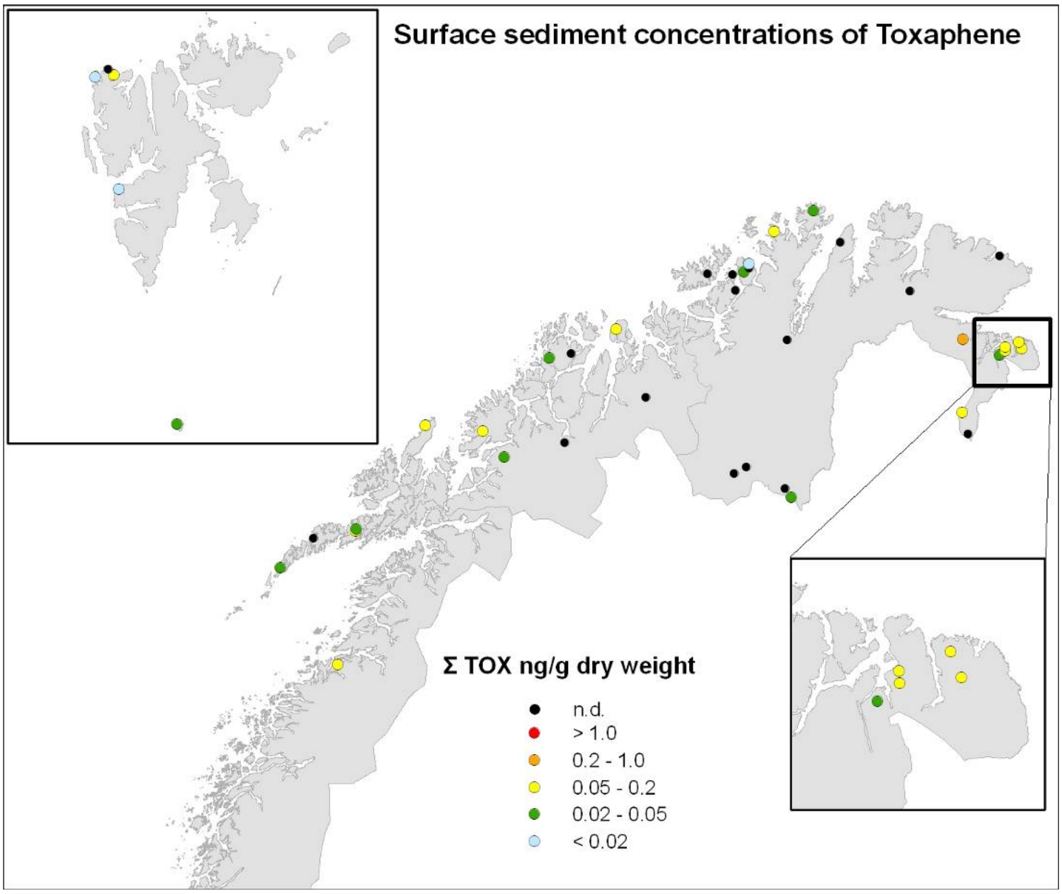


Figure 51. *Map illustrating concentrations of ∑Toxaphene in surface sediment (0 - 1 cm) from lakes on the mainland of Northern Norwegian and on Svalbard.*

Endrin, dieldrin, mirex:
Endrine were below the detection limit in all the analysed sediment samples. Dieldrin was only detected in one sediment sample, in very low concentrations (0.10 ng/g dw in sediment from Kongressvatn on Svalbard) (*Table 5*). Mirex were detected in 9 sediment samples, but also for mirex the concentrations were low (max 0.39 ng/g, Syltevikvatnet in Finnmark) (*Table 5*).

6.3.4 Polybrominated diphenyl ethers (PBDEs)

The ∑PBDE-concentration varied from 25.5 ng/kg dw (Kongressvatn, Svalbard) to 9 625 ng/kg dw (Lavvojavri, Finnmark). Generally PBDE-levels were low in sediment from the lakes in Nordland (average 84 ng/kg dw), higher in lakes from Troms (average 96 ng/g dw) and highest in lakes from Svalbard and Finnmark (average 817 and 881 ng/kg dw, respectively) (*Figure 52*; *Table 6*). BDE 99, 47 and 153 were the dominant congeners. BDE 209 was not detected in any of the analysed sediment samples. In most samples the PBDE-levels were several times lower than the PCB-concentrations in the same sediment samples, but in a few samples (generally those with the highest PBDE-levels) the PBDE-concentration exceeded the PCB-concentration. PBDEs were not included in the previous AMAP lake survey (Skotvold *et al.* 1997) so no assessments of time trends can be made. However, the levels in some of the lakes, especially in Finnmark (up to 9 625 ng/kg dw) are high compared to levels found in much more industrialised areas. For instance Song *et al.* (2004; 2005) have reported concentrations ranging from 500 - 4 000 ng/kg dw (sum of 9 PBDE congeners) in sediment samples from the Great Lakes, i.e. in an area that is located much closer to large industrial activities than the remote lakes on Svalbard.

The high levels in the Svalbard lakes (Ellasjøen 571 ng/kg dw, Arresjøen 2 383 ng/kg dw and Åsøvatn 962 ng/kg dw) could be related to seabird-activities, i.e. seabirds are transporting contaminants from the marine to the limnic ecosystem through the deposition of guano into the lakes (see Evenset *et al.* 2007b). The reason for the high levels in the Finnmark lakes is unknown.

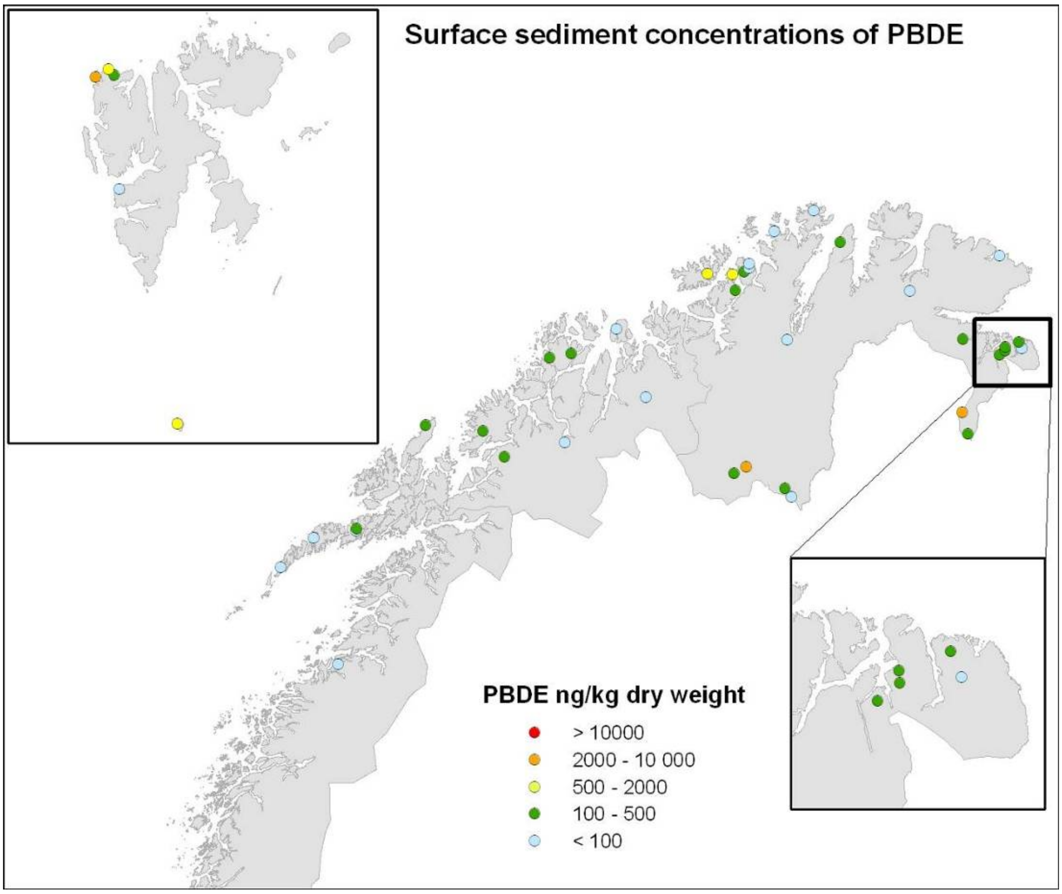


Figure 52. *Map illustrating concentrations of ∑PBDE in surface sediment (0 - 1 cm) from lakes on the mainland of Northern Norwegian and on Svalbard. Note that the unit is different (ng/kg dw) compared to the figures for other POPs.*

Table 6. *Concentrations of PBDEs and PCDD/PCDFs in surface sediment from lakes on the mainland of Northern Norway and on Svalbard. Concentrations are given as ng/kg dw.*

Name	Lake no.	∑PBDE	PCDD	PCDF	TEQs (WHO)
Valnesvatnet	210	41.5	2 919	344	33.5
Vikvatnet	224	47.7	-	-	-
Strumpvatnet	226	87.1	-	-	-
Storvatn	227	169	-	-	-
Storvatnet	232	103	-	-	-
Skøvatnet	235	212	-	-	-
Kapervann	236	121	-	-	-
Storvatnet	242	41.1	-	-	-
P Sørensensvatn	245	103	-	-	-
Langfjordvatnet	248	65.7	-	-	-
Josvatnet	250	29.8	-	-	-
Langvatnet	257	1445	1 296	185	16.6
Langvatnet	258	1152	-	-	-
Gukkesjavri	259	116	-	-	-
Dabmutjavri	260	52.5	-	-	-
Bakketækjavn	261	402	171	42.9	2.89
Russvikvatn	269	188	-	-	-
Gålgutjavri	274	59.5	-	-	-
Lavvojavri	279	9625	-	-	-
Avzejavri	280	344	-	-	-
Gavdnjajavri	282	266	-	-	-
Ravdojavri	283	100	31.5	30.2	1.00
Vuoååojavri	284	34.4	-	-	-
Syltevikvatnet	285	82.0	-	-	-
Råtjern	291	178	563	27.3	1.61
Følvatnet	298	5832	483	75.9	3.11
Ødevatnet	300	308	51.4	19.1	0.88
Andrevatn	301	147	81.3	271	26.7
Langvatnet	302	103	-	-	-
L. Ropelvvatnet	303	181	203	160	14.0
Langvatnet	312	54.4	901	86.6	13.3
Coalbmejavri	316	256	1 121	143	17.9
Kjeftavatn	319	64.5	-	-	-
Hestevatn	320	78.4	-	-	-
Storvikvatn	323	86.2	140	90	3.61
Trolldalsvatnet	325	54.5	-	-	-
Holmvatn	324	101	-	-	-
Ellasjøen	401	571	-	-	-
Arressjøen	501	2383	-	-	-
Kongressvatn	503	25.5	-	-	-
Rickardvatn	505	141	-	-	-
Åsøvatn	506	962	-	-	-
Min		25.53	31.5	19.1	0.88
Max		9625.32	1 296	271	33.5
Average		628.93	458	103	11.3
Median		109.49	203	86.6	8.5

Sum of BDE 17, 28, 49, 71, 47, 66, 100, 99, 85, 154, 153, 138, 183, 190, 208, 207, 206, 209

6.3.5 Dioxins and furans

Dioxins and furans were only analysed in sediment from 12 of the lakes (1 in Nordland, 1 in Troms and 10 in Finnmark) (*Table 6*). The levels were generally low, ranging from 1.0 ng TEQ/kg dw to 33.5 ng TEQ/kg dw. The highest concentration on a dry weight basis was found in sediment from Valnesvatn in Nordland and the lowest in Ravdojavri, located on Finnmarksvidda. However, if the organic content of the samples (LOI) are taken into consideration, the highest concentration was found in Andrevatn in Finnmark (395 ng TEQ/kg LOI), followed by Valnesvatn (121 ng TEQ/kg LOI). Dioxin-values above levels that are usually associated with only long-range transport were measured in 6 of the 12 lakes that were investigated for dioxins (ranked according to concentrations of dioxins: Andrevatn > Valnesvatn > Lille Ropelvvatn > Coalbmejavri > Langvatn (Sør-Varanger) > Langvatn (Sørøya)). Andrevatn, Lille Ropelvvatn, Coalbmejavri and Langvatn (Sør-Varanger) have probably been affected by dioxin emissions from AS Sydvaranger. High concentrations of dioxins have been reported from other lakes located in the dominant wind-direction from this industrial complex (Schlabach & Skotvold 1996). It is not known what the source for dioxins to Valnesvatn and Langvatn on Sørøya can be.

Arctic char from Lake Ellasjøen (401), Bjørnøya, Svalbard (photo: G. N. Christensen).

7. Results from fish investigations

Pooled fish samples, consisting of from 7 to 12 fish each, from 8 lakes were analysed for metals and selected POPs. Due to differences in local fauna different fish species were investigated from different lakes (*Table 1*, *Table 7*). In addition to the pooled samples 5 individual fish from Richardvatn and Åsøvatn on Svalbard were analysed for POPs. In the following text, the results from the analyses of pooled fish samples from the 8 lakes in Northern-Norway and on Svalbard are discussed first. The results from the analyses of individual fish are presented and discussed towards the end of the chapter.

7.1 Metals

Ten different metals were quantified in muscle samples from fish: As, Cd, Co, Cr, Cu, Hg, Ni, Pb, Se and Zn. Generally the metal concentrations were low in fish samples from all lakes (*Table 7*). The results also showed that the metal concentrations in the fish were quite uniform in all the investigated regions (low spread of data) (*Table 9*). The levels measured in the present investigation are comparable to metal levels that have been measured in fish samples previously collected in Northern- Norway, Sweden and Finland (AMAP 2005).

Hg is of special interest in fish, due to its high toxicity and potential for biomagnification. Hg-levels varied from 0.041 - 0.22 mg/kg ww in the analysed fish samples (*Table 7*). According to EU-regulations the maximum Hg-content in fish that are commercially available should be 0.5 mg/kg. All the fish samples that were analysed in the present study had significantly lower Hg-levels.

7.2 PAH

Fish are able to metabolise PAHs. Consequently low levels of PAHs occur in fish muscle samples unless the fish has been exposed to high concentrations of e.g. oil. In order to confirm that fish from the selected lakes within the AMAP region is safe for human consume, the pooled fish samples were also analysed for dicyclic and polycyclic aromatic hydrocarbons. In all sample, except one, the levels of all polycyclic aromatic compounds were below the analytical detection limit. In the sample from Øyangen on Bjørnøya a low concentration of phenentrene (1.26 ng/g ww) was measured (see *Appendix 4*). In three other samples (Valnesvatn, Langvatn and Åsøvatn) low levels of naphthalenes (13.6 - 50.2 ng/g ww) were measured (Appendix 4).

7.3 Persistent organic pollutants

7.3.1 PCBs

The levels of PCB in fish showed considerable variation between the investigated lakes. Low wet weight concentrations of PCBs were measured in fish from Valnesvatn, Holmvatn, Langvatn and Gavdnajavri ($\sum PCB_7$ from 1.79 - 4.60 ng/g ww). In the 4 other lakes the PCB-concentrations were significantly higher, with the highest concentration measured in Arctic char from Lake Ellasjøen on Bjørnøya ($\sum PCB_7$ = 118 ng/g ww) (*Table 7*). High concentrations of PCBs have also previously been measured in Arctic char from this lake (Evenset *et al.* 2004; 2005). The level measured in the present investigation was actually significantly lower than the levels measured in previous studies (e.g. Skotvold *et al.* 1997; Evenset *et al.* 2004). This might indicate that the PCB-levels have started to decline, but since levels of POPs also can vary with the size and age of the fish this is not possible to conclude based on the limited number of fish that are included in the sample from this lake. The high levels in Ellasjøen have been attributed to seabirds transporting POPs from the marine to the limnic environment through the deposition of guano. It is interesting to observe that a level comparable to that in fish from Ellasjøen was measured in fish from another seabird affected lake on Svalbard, Åsøvatn ($\sum PCB_7$ = 114 ng/g ww). The PCB-levels in fish from Øyangen ($\sum PCB_7$ = 26.8 ng/g ww) on Bjørnøya and Richardvatn on Spitsbergen ($\sum PCB_7$ = 17.7 ng/g ww) were higher than in fish from the lakes on the mainland of Norway, but lower than in the two seabird affected lakes (*Table 7*).

The lipid concentrations varied significantly between species (from 0.2 - 3.5 %). POPs are lipid-soluble, and therefore the highest concentrations usually occur in organisms with high lipid concentrations. In order to compare levels between different species and different regions it is common to normalise POP-concentrations to the lipid content in the samples. Lipid normalisation did not change the overall picture for PCBs (see *Table 8*). However, it should be noted that due to very low lipid concentrations in perch, the lipid normalised PCB-levels in perch from Gavdnajavri, were somewhat higher than the lipid normalised concentrations in fish from the other mainland lakes.

The dominant congeners in the fish samples were CB 153, followed by CB 138, 118 and 180.

7.3.2 Chlorinated pesticides

HCB:
The HCB-levels varied from 0.17 - 2.52 ng/g ww (19.7 - 86.4 ng/g lw). The highest levels (1.52 and 2.52 ng/g ww (86.4 and 84.8 ng/g lw)) were measured in fish from the two lakes on the northern edge of Svalbard (Table 7; Table 8). The lowest levels were measured in the fish from the lakes on the mainland of Northern Norway. However, due to the low lipid content in perch the lipid normalised concentrations in fish from Gavdnajavri were on the same level as in the fish from Svalbard (*Table 8*). Generally, the HCB-levels were in the same range as those that have been measured in comparable fish species within the AMAP region in previous studies (Skotvold *et al.* 1997; AMAP 2004), but the levels in fish from Richardvatn and Åsøvatn were in the upper range of previously recorded levels.

DDT:
The DDT-levels measured in the present study were generally relatively low, but also the DDT-levels were generally higher in fish from the Svalbard-lakes than in fish from the lakes in Northern-Norway (1.18 - 5.29 ng/g ww or 63.4 - 301 ng/g lw) (*Table 7*). However, the DDT-level in arctic char from Ellasjøen was several times lower in the present investigation than in the previous AMAP fish survey (Skotvold *et al.* 1997). As for the other POPs wet weight levels were low in perch from Gavdnajavri, but comparable to levels in Svalbard fish on a lipid weight basis (0.29 ng/g ww and 145 ng/g lw). *p,p'*-DDE was the dominant compound in all the fish samples.

HCH (α-, β- and γ-HCH):
HCHs were only detected in 4 of the 8 analysed fish samples. In Holmvatn, Langvatn, Gavdnajavri and Ellasjøen levels of all HCH-isomers were below the detection limit for the analytical method (see Appendix 4). Low levels were measured in fish from Valnesvatn (0.07 ng/g ww or 1.99 ng/g lw), Øyangen (0.23 ng/g ww or 6.6 ng/g lw), Richardvatn (0.26 ng/g ww or 14.8 ng/g lw) and Åsøvatn (0.52 ng/g ww or 17.5 ng/g lw) (*Table 7*; *Table 8*). α-HCH was the dominating isomer. This was somewhat surprising, since γ-HCH dominated in the fish samples that were analysed in the previous AMAP fish survey in Northern Norway and on Svalbard (Skotvold *et al.* 1997).

Chlordanes (heptachlor, heptachlor epoxide, oxychlordane, trans-chlordane, cis-Chlordane, trans-Nonachlor, cis-Nonachlor):
Low levels of chlordanes < lod - 0.88 ng/g ww or < lod - 49.4 ng/g lw) was measured in fish from all lakes except two. Fish from the two lakes on the northern edge of Svalbard, Åsøvatn and Richardvatn, had high levels of chlordanes (8.33 ng/g ww or 281 ng/g lw and 15.7 ng/g ww or 982 ng/g lw, respectively) (*Table 7*; *Table 8*). *Cis*-Nonachlor was the dominating chlordane compound followed by *trans*-Nonachlor.

Endrin, dieldrin and mirex:
Endrin or dieldrin was not detected in any of the analysed fish samples. Low concentrations of mirex (from 0.04 - 0.42 ng/g ww or from 1.14 - 24.7 ng/g lw) were measured in 4 of the 8 samples. The highest level was measured in fish from Ellasjøen on Bjørnøya.

Toxaphene (sum of parlar # 26, 50 and 62):
The toxaphene-concentration varied from 0.03 - 13.8 ng/g ww (6.3 - 783 ng/g lw). The lowest concentrations were measured in fish from Gavdnajavri in Finnmark and Øyangen on Bjørnøya, while the highest level was measured in fish from Richardvatn on Spitsbergen (*Table 7*; *Table 8*). Parlar no. 50 was the dominating compound in all the samples.

Polybrominated diphenyl ethers (PBDEs):
PBDEs were detected in all the analysed fish samples. In most lakes the PBDE-concentration in fish was slightly lower than the toxaphene-concentration. The PBDE-levels ranged from 0.03 - 1.92 ng/g ww (8.1 - 113 ng/g lw). The highest level was found in fish from Ellasjøen on Bjørnøya (*Table 7*; *Table 8*). However, the PBDE-level in fish from Ellasjøen was significantly lower than those reported by Evenset *et al.* (2005) for fish collected in the same lake in 1999. BDE 47, followed by BDE 99 and 100 were the dominant congeners in the fish samples from all regions.

Dioxins and furans:
Low levels of PCDDs/PCDFs were measured in all the analysed fish samples (*Table 7*; *Table 8*). The lowest level was measured in fish from Gavdnajavri (0.02 ng TEQ/kg ww or 8.50 ng TEQ/kg lw) and the highest in fish from Åsøvatn (0.28 ng TEQ/kg ww or 9.43 ng TEQ/kg lw) and Øyangen (0.30 ng TEQ/kg ww or 8.64 ng TEQ/kg lw) (*Table 7*; *Table 8*). However, all the samples had dioxin-concentrations that were well below the levels set for human consumption (4 ng TEQ/kg ww) by the EU (EU Commission Regulation 2001).

Elevated dioxin-concentrations were measured in the sediment sample from Valnesvatn and Langvatn (see chapter 6.3.5), but these were not reflected in elevated levels in fish. No data on sediment-concentrations of dioxins are available from the other lakes where fish samples were taken.

Table 7. *Concentrations of metals (wet weight) and POPs in pooled fish samples from lakes in Northern Norway and on Svalbard.*

Lake No.	**Unit**	**Valnesvatn (210)**	**Holmevatn (323)**	**Langvatn (257)**	**Gavdnajavri (282)**	**Ellasjøen (401)**	**Øyangen (402)**	**Richardvatn (505)**	**Åsøvatn (506)**
Species		Trout	Trout	Trout	Perch	Arctic char	Arctic char	Arctic char	Arctic char
Lipid	%	3,51	2,38	1,53	0,20	1,70	3,47	1,76	2,97
As	mg/kg	0,27	0,27	0,45	0,38	0,28	0,28	0,27	0,29
Cd	mg/kg	0,003	0,002	0,003	0,001	0,004	0,001	0,001	0,002
Co	mg/kg	0,011	0,011	0,018	0,011	0,07	0,016	0,058	0,034
Cr	mg/kg	0,061	0,029	0,044	0,028	0,045	0,055	0,042	0,051
Cu	mg/kg	0,42	0,60	0,32	0,78	0,37	0,66	0,82	0,38
Hg	mg/kg	0,154	0,026	0,066	0,22	0,078	0,041	0,058	0,194
Ni	mg/kg	0,018	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pb	mg/kg	0,015	0,016	0,016	0,024	0,02	0,015	0,017	0,020
Se	mg/kg	0,68	1,43	1,07	0,38	1,57	1,25	2,17	1,81
Zn	mg/kg	9,76	6,72	4,36	4,67	6,57	5,57	8,14	6,73
∑PCB7	ng/g	4,31	4,60	3,05	1,79	118	26,85	17,7	114
∑PCB	ng/g	7,77	8,55	5,26	2,45	155	38,5	30,8	144
HCB	ng/g	0,69	0,48	0,47	0,17	0,88	0,82	1,52	2,52
∑ DDT	ng/g	0,88	0,95	0,58	0,29	1,18	2,20	5,29	4,55
∑HCH	ng/g	0,07	0,00	0,00	0,00	0,00	0,23	0,26	0,52
∑Chlordanes	ng/g	0,88	0,73	0,53	0,00	0,84	0,68	15,7	8,33
Endrin	ng/g	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dieldrin	ng/g	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mirex	ng/g	0,04	0,00	0,00	0,00	0,42	0,27	0,00	0,24
∑Tox	ng/g	1,34	0,37	0,56	0,03	1,52	0,22	13,78	5,10
∑PBDE	ng/g	0,57	0,26	0,29	0,03	1,92	0,28	0,42	1,17
PCDD/PCDF	ng TEQ/kg	0,15	< lod	0,20	0,017	0,22	0,30	0,013	0,28

Table 8. *Lipid normalised concentrations of POPs in pooled fish samples from lakes in Northern Norway and on Svalbard.*

Lake No.	**Unit**	**Valnesvatn (210)**	**Holmevatn (323)**	**Langvatn (257)**	**Gavdnajavri (282)**	**Ellasjøen (401)**	**Øyangen (402)**	**Richardvatn (505)**	**Åsøvatn (506)**
Species		Trout	Trout	Trout	Perch	Arctic char	Arctic char	Arctic char	Arctic char
Lipid	%	3,51	2,38	1,53	0,20	1,70	3,47	1,76	2,97
∑PCB7	ng/g	123	193	199	895	6 941	774	1 006	3 838
∑PCB	ng/g	222	359	344	1 225	9 118	1 110	1 750	4 849
HCB	ng/g	19,7	20,2	30,7	85,0	51,8	23,6	86,4	84,8
∑ DDT	ng/g	25.1	39,9	37,9	145	69,4	63,4	301	153
∑HCH	ng/g	1,99	0,00	0,00	0,00	0,00	6,6	14,8	17,5
∑Chlordanes	ng/g	25.1	30,7	34,6	0,00	49,4	19,6	892	281
Endrin	ng/g	0,00	0,00	0,00	0,00	0,0	0,00	0,00	0,00
Dieldrin	ng/g	0,00	0,00	0,00	0,00	0,0	0,00	0,00	0,00
Mirex	ng/g	1,14	0,00	0,00	0,00	24,7	7,8	0,00	8,08
∑Tox	ng/g	38,2	15,5	36,6	15,0	89,4	6,3	783	172
∑PBDE	ng/g	16,2	10,9	19,0	15,0	113	8,1	23,9	39,4
PCDD/PCDF	ng TEQ/kg	4,27	< lod	13,1	8,50	12,9	8,64	0,74	9,43

Table 9. *Average, minimum, maximum, and median concentrations of metals and POPs in fish from 8 lakes in Northern Norway and on Svalbard, 2004 - 2006.*

Element	Unit	Average	Min	Max	Median	n
Metals						
As	mg/kg	0,33	0,27	0,46	0,28	8
Cd	mg/kg	0,002	0,001	0,004	0,002	8
Co	mg/kg	0,03	0,01	0,07	0,02	8
Cr	mg/kg	0,04	0,03	0,06	0,04	8
Cu	mg/kg	0,54	0,32	0,82	0,51	8
Hg	mg/kg	0,10	0,03	0,22	0,07	8
Ni	mg/kg	<0.010	<0.010	0,02	-	8
Pb	mg/kg	0,02	0,02	0,02	0,02	8
Se	mg/kg	1,30	0,38	2,17	1,34	8
Zn	mg/kg	6,57	4,36	9,76	6,65	8
$\sum PCB_7$	ng/g	34,28	1,79	117,85	11,16	8
∑PCB	ng/g	49,01	2,45	154,61	19,67	8
HCB	ng/g	0,94	0,17	2,52	0,76	8
∑HCH	ng/g	0,14	n.d	0,52	0,04	8
∑Chlordanes	ng/g	3,46	0,00	15,71	0,79	8
∑DDT	ng/g	1,99	0,29	5,29	1,07	8
∑Toxaphenes	ng/g	2,55	0,03	13,8	0,56	8
∑PBDE	ng/g	0,55	0,03	1,92	0,29	8
∑PCDD/PCDF	ng TEQ/kg	0,15	0,01	0,30	0,18	8

7.4 Analyses of single fish from Richardvatn and Åsøvatn, Svalbard

Five relatively large individuals of Arctic char from Richardvatn and Åsøvatn were analysed individually. The fish from Richardvatn were from 431 - 702 g, while the fish from Åsøvatn were larger (705 - 2 400 g) (*Table 2*). The lipid content in the muscle samples showed large variations, from 0.41 - 7.24 % in fish from Richardvatn and from 1.21 - 10.0 % in fish from Åsøvatn (*Table 10*). The average lipid concentration was higher in fish from Åsøvatn (6.92 %) than in fish from Richardvatn (2.80 %).

7.4.1 PCBs

High levels of PCBs, ranging from $\sum PCB_7$ = 14.0 - 388 ng/g ww or 537 - 17 190 ng/g lw, were measured in all the analysed fish from the two lakes on Svalbard. This was considerably higher than the levels measured in pooled fish from Northern Norway (*Table 7*; *Table 8*). The highest levels were measured in the fish from Åsøvatn (average $\sum PCB_7$ = 232 ng/g ww or 5 666 ng/g lw). CB 153 was the dominant congener, followed by CB 138, 180 and 118 (see Appendix 4). The higher concentration in the fish from Åsøvatn can be due to the size of the fish, since there was a good correlation between the size of the fish and the concentration of PCB (*Figure 53*). Another reason for the high levels can be that Åsøvatn is affected by seabirds, and these birds may transport POPs from the marine to the limnic environment (Evenset *et al.* 2007b). The PCB-levels in Arctic char from Åsøvatn were in the same range or slightly lower than levels that previously have been measured in Arctic char from Ellasjøen on Bjørnøya. Ellasjøen is heavily affected by seabirds, but also receive a considerable amount of precipitation, which also enhances the deposition of POPs.

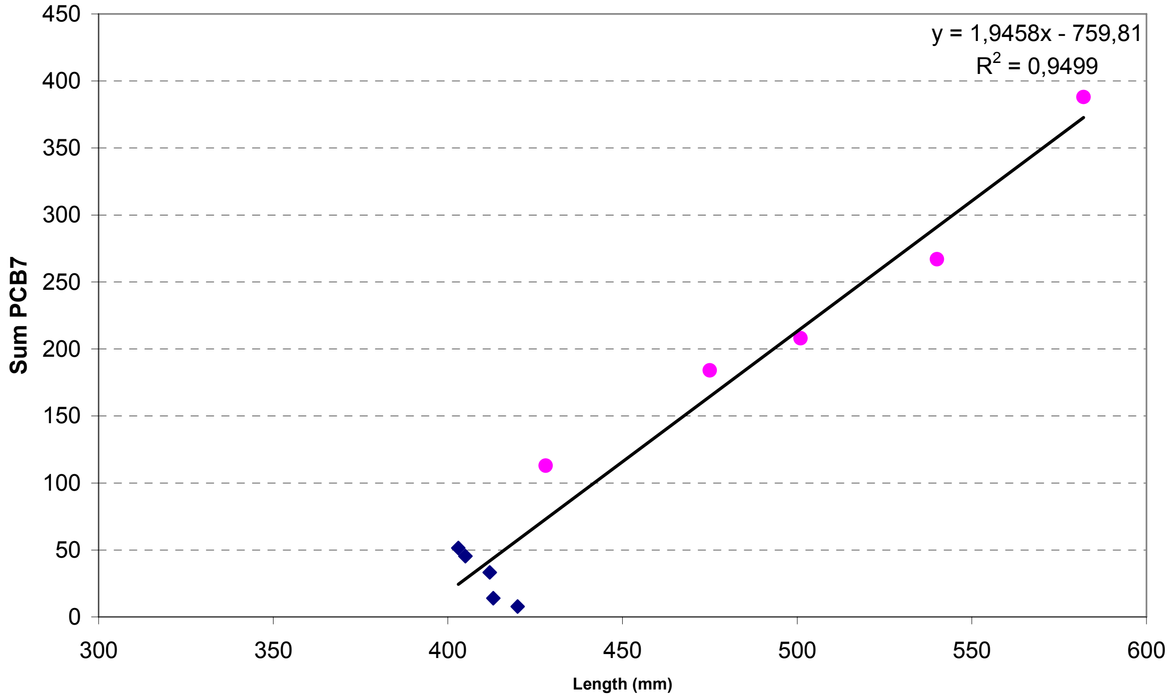


Figure 53. *Correlation between the length of the fish and the concentration of* $\sum PCB_7$. *Fish from Richardvatn are shown with blue quadrates, while the fish from Åsøvatn are shown with pink dots.*

7.4.2 Chlorinated pesticides

HCB:

The HCB-levels were relatively high, especially in fish from Åsøvatn (from 1.45 - 7.42 ng/g ww, or from 61.3 - 120 ng/ g lw) (*Table 10*). As for PCBs, the HCB-levels were higher in the fish from the two Svalbard lakes than in fish from Northern Norway (*Table 7*; *Table 8*).

DDT:

The DDT-levels varied from 2.84 - 16.7 ng/g ww or 7.6 - 1 224 ng/g lw in fish from Richardvatn and from 36.4 - 83.9 ng/g ww or 489 - 4 843 ng/g lw in fish from Åsøvatn (Table 10). The DDT-levels in fish from the two Svalbard-lakes were considerably higher than in the pooled fish samples from Northern-Norway and also Bjørnøya (*Table 7*; *Table 8*). *p,p'*-DDE was the dominant compound in all the fish samples. *o,p*'-DDE was not detected in any of the samples (see Appendix 4).

HCH (α-, β- and γ-HCH):

α-HCH was the dominant isomer in most of the fish samples from Richardvatn and Åsøvatn, but at least two isomers were detected in 8 of the 10 samples (see Appendix 4). The highest HCH-concentration on a lipid basis was measured in a fish from Richardvatn (61.0 ng/g lw), and also the average lipid-normalised HCH-concentration was higher in fish from Richardvatn (24.7 ng/g lw) than in fish from Åsøvatn (12.4 ng/g lw). However, the highest wet weight concentrations were measured in fish from Åsøvatn (0.18 - 1.28 ng/g ww) (*Table 10*).

Chlordanes (heptachlor, heptachlor epoxide, oxychlordane, trans-chlordane, cis-Chlordane, trans-Nonachlor, cis-Nonachlor):
The chlordane concentrations were relatively high in all the fish from both lakes (from 8.79 - 42.3 ng/g ww or 137 - 2 683 ng/g lw) (*Table 10*). This is considerably higher than the levels measured in the pooled fish samples from Northern Norway and also Bjørnøya (*Table 7*; *Table 8*). *Cis*- and *trans*-nonachlor were the dominant chlordane compounds, constituting from 74 - 93 % of sum chlordanes (see Appendix 4).

Endrin, dieldrin and mirex:
Endrin was only detected in one fish from Richardvatn, and dieldrin in one fish from Åsøvatn. Mirex was detected in 4 of the 5 analysed fish from Richardvatn, but only in one individual from Åsøvatn (*Table 10*). The concentrations were higher than those measured in pooled fish samples collected in Northern Norway and on Bjørnøya (*Table 7*; *Table 8*). Use of endrin, dieldrin or mirex as pesticides has been prohibited in most countries, but mirex is still used as a flame retardant in the United States.

7.4.3 PBDEs
Fish from Åsøvatn had higher concentrations of PBDEs than the fish from Richardvatn (average ∑PBDE 3.52 ng/g ww or 86.3 ng/g lw in fish from Åsøvatn compared to 0.79 ng/g ww or 58.0 ng/g lw in fish from Richardvatn) (*Table 10*). PBDE followed the same pattern as PCBs, with the highest concentrations in the largest individuals. The PBDE-concentrations measured in the individual fish from the two Svalbard lakes were considerably higher than the levels measured in pooled fish samples from lakes in Northern Norway (*Table 7*; *Table 8*). Only 9 (BDE 28, 47, 49, 66, 71, 99, 100, 153, 154) of the 18 analysed congeners were detected in the fish samples (see Appendix 4). BDE 47 was the dominant congener in the fish samples, followed by BDE 99 and 100.

7.4.4 Hg
The Hg-concentration was higher in fish from Åsøvatn (average 205 ng/g ww) than in fish from Richardvatn (average 77.8 ng/g ww). The Hg-concentrations were in the same range as those measured in pooled fish samples from Northern Norway and Bjørnøya (*Table 7*; *Table 8*). According to EU-regulations the maximum Hg-content in fish that are commercially available is 0.5 mg/kg. All the fish from the two Svalbard lakes had lower Hg-levels.

Table 10. *Concentrations of POPs and Hg in muscle samples from single fish collected in Richardvatn and Åsøvatn on Svalbard, 2005. In the upper table all concentrations are given as ng/g wet weight, while the concentrations are given as ng/g lw in the lower table.*

Wet weight basis:

Sample	Lipid %	∑PCB_7	∑PCB	HCB	∑DDT	∑HCH	∑chlord.	Endr.	Dieldr.	Mirex	∑PBDE	Hg
R1	0.41	17.5	32.7	0.42	5.02	0.25	11.0	<lod	<lod	0.17	0.49	83
R2	1.45	7.79	15.2	1.36	2.84	0.19	10.9	<lod	<lod	<lod	0.45	53
R4	0.76	33.2	55.9	4.68	6.25	0.21	8.79	0.31	<lod	0.32	0.73	140
R5	7.24	45.4	83.5	4.98	14.7	0.55	27.3	<lod	<lod	0.54	1.16	49
R6	4.18	51.4	207	2.86	16.7	0.60	42.3	<lod	<lod	0.53	1.14	64
Å9	9.5	388	575	7.42	83.9	0.89	41.3	<lod	0.14	0.95	4.95	374
Å10	10.0	267	402	6.78	71.7	1.28	20.2	<lod	<lod	<lod	4.13	29
Å11	1.21	208	309	1.45	58.6	0.18	15.3	<lod	<lod	<lod	3.13	313
Å12	6.41	184	267	4.47	55.2	0.75	14.1	<lod	<lod	<lod	3.18	190
Å13	7.45	113	168	4.57	36.4	0.98	10.2	<lod	<lod	<lod	2.19	119

Lipid weight basis:

Sample	Lipid %	∑PCB7	∑PCB	HCB	∑DDT	∑HCH	∑chlord.	Endr.	Dieldr.	Mirex	∑PBDE
R1	0.41	3 415	6 463	102	1 224	61.0	2 683	<lod	<lod	41.5	119.5
R2	1.45	537	1 048	93.8	196	13.1	752	<lod	<lod	<lod	31.0
R4	0.76	4 368	7 355	616	822	27.6	1157	40.8	<lod	42.1	96.1
R5	7.24	627	1 153	68.8	203	7.60	377	<lod	<lod	7.46	16.0
R6	4.18	1 230	4 952	68.4	400	14.4	1012	<lod	<lod	12.7	27.3
Å9	9.50	4 084	6 053	78.1	883	9.37	435	<lod	1.47	10.0	52.1
Å10	10.0	2 670	4 020	67.8	717	12.8	202	<lod	<lod	<lod	41.3
Å11	1.21	17 190	25 537	120	4 843	14.9	1264	<lod	<lod	<lod	259
Å12	6.41	2 871	4 165	69.7	861	11.7	220	<lod	<lod	<lod	49.6
Å13	7.45	1 517	2 255	61.3	489	13.2	137	<lod	<lod	<lod	29.4

References

Alaee, M., J. Luross, D.B. Sergeant, D.C.G. Muir, K. Solomon & D.M. Whittle. 1999. Distribution of polybrominated diphenyl ethers in the Canadian environment. *Organohal. Comp*. 40: 347-350.

AMAP 2004. AMAP Assessment 2002: Persistent Organic Pollutants in the Arctic. Arctic Monitoring and Assessment Programme, Oslo, Norway, 309 p.

AMAP 2005. AMAP assessment 2002: Heavy metals in the Arctic. Arctic Monitoring and assessment Programme, Oslo, Norway, 261 p.

Amundsen, P-A., N. Kashulin, I. Koroleva, K.Ø Gjelland, P. Terentiev, C. Lien, L. Dalsbø, S. Sandimirov, L. Kudryavtseva & R. Knudsen. 2006. Ecology and heavy metals contamination of fish in the Paz watercourse. Report Norwegian College of Fishery Science.

Andersson, P. & H. Borg. 1988. Effects of liming on the distribution of cadmium in water, sediments, sediments and organisms in a Swedish lake. *Can. J. Fish. Aquat. Sci.* 45: 1154-1162.

Barrie, L.A. D.Gregor, B. Hargrave, R.Lake, D. Muir, R. Shearer, B. Tracey & T. Bidleman. 1992. Arctic contaminants: sources, occurence and pathways. *Sci. Tot. Environ.*, 122: 1-74.

Bergkvist, B., L. Folkeson, & D. Berggren. 1989. Fluxes of Cu, Zn, Pb, Cd, Cr and Ni in temperate forest ecosystems. A literature review. *Water Air Soil Pollut.* 47: 217 - 286.

Brännvall, M.-L., R. Bindler, O. Emteryd, M. Nilsson & I. Renberg. 2001. Stable isotope and concentration records of atmospheric lead pollution in peat and lake sediments in Sweden. Water, Air, Soil Pollut. 100, 243-252.

Carigan.R. & A.Tessier. 1985. Zinc deposition in acid lakes: The role of diffusion. *Science* 228: 1524-26.

Christensen, G.N., A. Evenset, S. Rognerud, B.L. Skjelkvåle, R. Palerud, E. Fjeld & O. Røyset. 2008. *This report.* National lake survey 2004-2006, PART III: AMAP. Status of metals and environmental pollutants in lakes and fish from the Norwegian part of the AMAP region. NIVA-rapport; LNO-5550/2008, Statlig program for forurensningsovervåking, SPFO rapport; 1012/2008, SFT-rapport TA-2363/2008. Statens forurensningstilsyn (SFT), Oslo.

Christensen, G.N., V. Savinov, T. Savinova, L. Alexeeva, A. Kochetkov, A. Konoplev, D. Samsonov, V.A. Dauvalter, N.A. Kashulin & S.S. Sandimirov. 2007. Screening studies on POP levels in bottom sediments from selected lakes in the Paz watercourse. 2007a. Akvaplan-niva report 3365.01.

Christensen, G.N., V. Savinov, T. Savinova, L. Alexeeva, A. Kochetkov, A. Konoplev, D. Samsonov, V.A. Dauvalter, N.A. Kashulin, S.S. & D. Morozov. 2007b. Screening studies on POP levels in fish from the selected lakes in Paz watercourse. 2007. Akvaplan-niva report 3365.02.

Dauvalter, V. & S. Rognerud 2002. Concentrations of mercury in lake sediments in the boarder area between Russia and Norway. Impacts of POPs and mercury on Arctic environments and humans. AMAP conference and workshop, Abstract 7, Tromsø.

Dauvalter, V. 1994. Heavy metals in lake sediments of the Kola Peninsula, Russia. *Sci. Tot. Environ*. 158: 51-61.

de March, B.G.E., C. de Wit, D.C.G. Muir, B.B. Braune, D.J. Gregor, R.J. Norstrom, M. Olsson, J.U. Skaare & K. Stange. 1998. Persistent Organic Pollutants. Chapter 6, pp. 183-372 in: AMAP assessment report: Arctic pollution issues. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xii + 859 pp.

de Wit, C. 2002. An overview of brominated flame retardants in the environment. *Chemosphere* 46: 583-624.

Dietz, R., J. Pacyna, D.J. Thomas, G. Asmund, V.V. Gordeev, P. Johansen, V. Kimstach, L. Lockhart, S. Pfirman, F. Riget, G. Shaw, R. Wagemann & M. White. 1998. Heavy metals. Chapter 7, pp. 373-524 in: AMAP assessment report: Arctic pollution issues. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xii + 859 p.

EU commission Regulation 2001. Opinion of the scientific committee on food on the risk assessment of dioxins and dioxin-like PCBs in food - update based on new scientific information available since the adoption of the SCF opinion of 22nd November 2000. http://ec.europa.eu/food/fs/sc/scf/out90_en.pdf

Evenset, A. G.N. Christensen & R. Kallenborn 2005. Selected chlorobornanes, polychlorinated naphthalenes and brominated flame retardants in Bjørnøya (Bear Island) freshwater biota. *Environmental Pollution* 136: 419-430.

Evenset, A., G.N. Christensen, T. Skotvold, E. Fjeld, M. Schlabach, E. Wartena & D. Gregor. 2004. A comparison of organic contaminants in two high Arctic lake ecosystems, Bjørnøya (Bear Island), Norway. *Sci. Tot. Environ.* 318, 125-141.

Evenset, A., G.N. Christensen, J. Carroll, A. Zaborska, U. Berger, D. Herzke & D. Gregor. 2007a. Historical Trends in Persistent Organic Pollutants and Metals Recorded in Sediment from Lake Ellasjøen, Bjørnøya, Norwegian Arctic. *Environmental Pollution* 146: 196-205.

Evenset, A., J. Carroll, G.N. Christensen, R. Kallenborn, D. Gregor & G.W. Gabrielsen. 2007b. Seabird guano is an efficient conveyor of persistent organic pollutants to arctic lake ecosystems. *Environmental Science & Technology* 41: 1173-1179.

Gregor, D.J. & W. Gummer. 1989. Evidence of atmospheric transport and deposition of organoclorine pesticides and PCB in Canadian arctic snow. Environ. Sci. Technol., 23 (5): 561-565.

Gregor, D.J., H. Loeng & L. Barrie. 1998. The influence og physical and chemical processes on contaminant transport into and within the Arctic. In: arctic Monitoring and Assessment Reprort, Arctic pollution Issues. Arctic Monitoring and Assessment Programme, pp. 25-116. Oslo, Norway.

Håkanson, L. 1984. Metals in fish and sediments from River Kolbäksån water system, Sweden. Arch. Hydrobiol. 101: 373-400.

Hart, B.T. 1982. Uptake of trace metals by sediments and suspended particulates: a review. Hydrobiologia 91: 299-313.

Herzke, D., G.W. Gabrielsen, A. Evenset, & I.C. Burkow. 2003. Polychlorinated camphenes (Toxaphenes) and polybrominated diphenylethers in glaucous gull (Larus hyperboreus) from Svalbard and Bjørnøya (Bear Island). *Environ. Poll.* 121: 293-300.

Holtan, H., Rosland, D. S. 1992. Klassifisering av miljøkvalitet i ferskvann. SFT-veiledning nr. 92:06. 32 pp.

Jansson, B., L. Asplund & M. Olsson. 1987. Brominated flame retardants - ubiquitous environmental pollutants? *Chemosphere* 16: 2343-2349.

Jansson, B., R. Andersson, L. Asplund, K. Litzen, K. Nylund, U. Sellström, U-B. Uvemo, C. Wahlberg, U. Wideqvist, T. Odsjå & M. Olssen. 1993. Chlorinated and brominated persistent organic compounds in biological samples from the environment. *Environ. Toxicol. Chem*. 12:1163-1174.

Kvernheim, A.L., E.M. Brevik, K. Næs, E. Oug, J. Klungsøyr, A. Molven & A. Goksøyr. 1992. Organochlorines and PAHs in the Marine Environment. In: Molven, A. & Goksøyr, A. (eds), State of art and Research Needs. NTNF Programme on Marine Pollution, Oslo; 120 pp.

Larsen, J., P.G. Appleby, I. Eide, G.N. Christensen & Berg, T. Submitted 2008. Historical and geographical trends in sediment chronology from lakes and marine sites along the Norwegian coast.

Lithner, G. & K. Holm. 2003. Nya metaller og föroreningar i svensk miljø. Institutet för tillämpad miljøforskning, Stockholms Universitet. Rapport 5306, 76 s.

Macdonald, R.W., L.A. Barrie, T.F. Bidleman, M.L. Diamond, D.J. Gregor, R.G. Semkin, W.M.J. Strachan, Y.F. Li, F. Wania, M. Alaee, L.B. Alexeeva, S.M. Bascus, R. Bailey, J.M. Bewers, C. Gobeil, C.J. Halsall, T. Harner, J.T. Hoff, L.M.M. Jantunen, W.L Lockhart, D. Mackay, D.C.C. Muir, J. Pudykiewicz, K.J. Reimer, J.N. Smith, G.A. Stern, W.H. Schroeder, R. Wagemann & M.B. Yunker. 2000. Contaminants in the Canadian Arctic: 5 years of progress in understanding sources, occurrence and pathways. *Sci. Tot. Environ.* 254, 93-234.

MacDonald, R.W., T. Harner, J. Fyfe, H. Loeng & T. Weingartner. 2003. AMAP Assessment 2002: The influence of global change on contaminant pathways to, within, and from the arctic. Arctic Monitoring and Assessment Programme, Oslo, Norway.

Mackay D. & F. Wania. 1995. Transport of contaminants to the Arctic: partitioning, processes and models. *Sci. Total Environ.* 160/161: 25-38.

Mudroch, A. & J.M. Azcue. 1995. Manual of Aquatic Sedimint Sampling. Lewis Publishers, London.

Oehme, M., J.-E. Haugen & M. Schlabach. 1995. Ambient air levels of persistent organochlorines in spring 1992 at Spitsbergen and the Norwegian mainland: comparison with 1984 results and quality control measures. *Sci. Total Environ.* 160/161: 139-152.

Pacyna, J.M., B.D. Shin & P. Pacyna. 1993. Global emissions of lead. Atmospheric Environment Service. Environment Canada, Ottawa, Canada.

Renberg, I., Wik-Persson, M., & Emteryd, O. 1994. Pre-industrial atmospheric lead contamination detected in Swedish lake sediments. Nature 368, 323-326.

Rognerud, S. & E. Fjeld. 2001. Trace element contamination of Norwegian lake sediments. *Ambio* 30, 11-19.

Rognerud, S. & E. Fjeld. 1993. Regional survey of heavy metals in lake sediments in Norway. *Ambio* 22: 206-212.

Rognerud, S., D. Hongve, E. Fjeld & R.T. Ottesen. 2000. Trace metal concentrations in lake and overbank sediments in southern Norway. *Environmental Geology* 39: 723-732.

Rognerud, S., E. Fjeld, B.L. Skjelkvåle, G.N. Christensen & O. Røyset. 2008. Nasjonal innsjøundersøkelse 2004–2006, del 2: Sedimenter. Forurensning av metaller, PAH og PCB. NIVA-rapport; LNO-5549/2008, Statlig program for forurensningsovervåking, SPFO rapport; 1011-2008, SFT-rapport TA-2632/2008. Statens forurensningstilsyn (SFT), Oslo. 77 pp.

Rühling, A. & E. Steinnes. 1998. Atmospheric heavy metal deposition in Europe 1995-1995. Nord 1998:15.

Rühling, Å., L. Rasmussen, K. Pilegaard, A. Mäkinen & E. Steinnes. 1987. Survey of atmospheric heavy metal deposition. Nordisk Ministerråd Nord. 1987.21. 44 pp.

Schlabach, M. & T. Skotvold 1996. Undersøkelse av PCDD/PCDF I næringsmidler I Sørvaranger. NILU report OR 29/96, O-94120. 18 p + appendix.

Skjelkvåle, B.L., S. Rognerud, G.N Christensen, E. Fjeld & O. Røyset. 2008. Nasjonal innsjøundersøkelse 2004-2006, DEL I: Vannkjemi. Status for forsuring, næringssalter og metaller. NIVA-rapport; LNO-5548/2008, Statlig program for forurensningsovervåking, SPFO rapport; 1010/2008, SFT-rapport TA-2631/2008. Statens forurensningstilsyn (SFT), Oslo.

Skotvold, T., E. Wartena & S. Rognerud. 1997. Heavy metals and persistent organic pollutants in sediments and fish from lakes in Northern and Arctic regions of Norway. Statlig

program for forurensningsovervåkning, Norwegian Pollution Control Authority report 688/97. TA 11427/1997. Akvaplan-niva report 514.660.1. 97 p.
Song, W., J.C .Ford, A. Li, W.J. Mills, D.R. Buckley & K.J. Rockne. 2004. Polybrominated diphenyl ethers in the sediments of the Great Lakes. 1. Lake Superior. *Environmental Science & Technology* 38: 3286-3293.
Song, W.L., A. Li, J.C. Ford, N.C. Sturchio, K.J. Rockne, D.R. Buckley & W.J. Mills. 2005. Polybrominated diphenyl ethers in the sediments of the Great Lakes. 2. Lakes Michigan and Huron. *Environmental Science & Technology* 39: 3474-3479.
Steinnes, E, A. Hendriksen, J.P. Rambæk & N.B. Vogt. 1994. Atmospheric deposition of trace metals Norway: temporal and spatial trends studied by moss analyses. *Water Air Soil Pollut.* 74: 121-140.
Steinnes, E., O.O. Hvatum, B. Bolviken, & P. Varskog. 2005. Atmospheric pollutants and trace gases. *Journal of Environmental Quality* 34:192-197.
Verreault, J., R.J. Letcher, D.C.G. Muir, S. Chu & G.W. Gabrielsen. 2004. New and established organohalogen contaminants and their metabolites in plasma and eggs of glaucous gulls from Bear Island. Final report (2003/2004) to the Norwegian Pollution Control Authority (SFT), Oslo, Norway, 2004, 26 pp.
Wania, F. & R. Mackay. 1995. A global distribution model for persistent organic-chemicals. *Sci. Tot. Environ*. 161: 211-232.

8. Appendix

8.1 Appendix 1: Primary data for the lakes included in this study

No.	Station name	Municipality	County	Latitude	Longitude	Lake area km2	Altitude mas	Map nr.
194	Elgviddvatnet	Grane	Nordland	65,425	13,058	1,55	595	1825-1
195	Øvre Sørvatn	Vefsn	Nordland	65,743	12,997	0,78	267	1826-2
196	Krokvatnet	Vefsn	Nordland	66,087	13,685	1,33	406	1927-3
197	Skittreskvatnet	Hattfjelldal	Nordland	65,845	14,283	0,44	602	2026-4
198	Langtjørna	Hattfjelldal	Nordland	65,846	14,351	0,34	896	20264
199	Gråvatnet	Rana	Nordland	66,389	13,372	2,79	99	1927-4
202	Grønåsvatnet	Meløy	Nordland	66,746	13,658	1,05	83	19283
203	Markavatnet	Meløy	Nordland	66,906	13,758	2,28	26	19281
204	Storvikvatnet	Gildeskål	Nordland	66,958	13,859	0,66	183	19281
205	Straitasjavri	Saltdal	Nordland	66,583	15,523	0,91	968	2128-3
206	Kjemåvatn	Saltdal	Nordland	66,770	15,411	2,60	626	2128-4
207	Øvre Sølvbakk	Saltdal	Nordland	67,055	15,845	0,32	707	2129-2
208	Fiskeløysvatnet	Saltdal	Nordland	67,075	15,847	2,28	743	2129-2
210	Valnesvatnet	Bodø	Nordland	67,143	14,443	4,91	121	20293
211	Steigtindvatnet	Bodø	Nordland	67,404	14,760	1,74	58	20291
213	Trolltindvatnet	Bodø	Nordland	67,470	14,942	1,27	233	2029-1
215	Tennvatn	Sørfold	Nordland	67,763	15,931	2,62	339	2130-1
218	Kjerrvatn	Tysfjord	Nordland	68,078	16,034	1,40	209	1231-2
219	Kilvatnet	Hamarøy	Nordland	68,143	16,011	5,97	94	1231-2
222	Fageråvatnet	Flakstad	Nordland	68,020	13,044	0,29	146	1031-3
223	Storvatn	Flakstad	Nordland	68,054	13,350	1,10	25	1031-2
224	Vikvatnet	Vestvågøy	Nordland	68,195	13,580	0,55	10	1031-2
225	Dalvatnet / Bøvatnet	Vestvågøy	Nordland	68,316	13,945	0,42	37	1131-4
226	Strumpvatnet	Vågan	Nordland	68,299	14,535	0,27	265	1131-1
227	Storvatn	Vågan	Nordland	68,318	14,541	1,01	17	1131-1
228	Løynvatn	Hadsel	Nordland	68,443	15,270	0,47	264	1231-4
229	Trolldalsvatn (Rekvatn)	Øksnes	Nordland	68,752	14,983	0,37	29	1132-1
231	Finnsætervatnet	Andøy	Nordland	68,848	15,811	0,85	284	1232-1
232	Storvatnet	Andøy	Nordland	69,255	15,938	1,73	28	1233-1
233	Sverigedalsvatnet	Andøy	Nordland	69,215	16,005	0,27	183	1233-2
234	Rundnakkvatnet	Andøy	Nordland	69,200	15,959	0,24	194	1233-2
235	Skøvatnet	Dyrøy	Troms	69,030	17,874	6,16	180	1433-3
236	Kapervann	Tranøy	Troms	69,241	17,329	0,67	214	1333-2
237	Øvre Kaperdalsvatn	Tranøy	Troms	69,277	17,386	0,49	194	1333-1
238	Kapervatnet	Tranøy	Troms	69,247	17,411	1,35	168	1433-3
239	Storvatnet	Berg	Troms	69,403	17,175	0,19	141	1333-1
240	Øvre Vasskardvatnet	Bardu	Troms	68,698	18,869	0,29	662	1532-3
241	Aslatjavri	Målselv	Troms	68,897	19,982	0,60	874	1632-4
242	Storvatnet	Balsfjord	Troms	69,169	19,309	1,44	128	1533-2
243	Tårnvatnet	Lenvik	Troms	69,312	18,358	3,18	108	1433-1
244	Store Synnfjordvatnet	Tromsø	Troms	69,589	18,362	0,66	305	1434-2
245	Peder Sørensensvatn	Tromsø	Troms	69,895	18,870	0,35	109	1534-4
247	Botnvatnet	Karlsøy	Troms	70,080	19,808	0,29	332	1535-2
248	Langfjordvatnet	Skjervøy	Troms	70,150	20,537	0,50	65	1635-2
250	Josvatnet	Nordreisa	Troms	69,569	21,259	0,52	72	1734-3
251	Cearpmatjavri	Nordreisa	Troms	69,693	21,633	0,56	771	1734-2

252	Junttejavri	Kvænangen	Troms	69,619	21,874	0,84	835	1734-2
253	Bjørndalvatna	Loppa	Finmark	70,216	21,630	0,34	220	1735-2
254	Låvtajavri	Loppa	Finmark	70,178	21,644	0,84	200	1735-2
256	Hesteskovatnet	Alta	Finmark	70,175	22,592	0,33	354	1835-3
257	Langvatnet	Hasvik	Finmark	70,615	22,866	0,50	285	1836-2
258	Langvatnet	Hammerfest	Finmark	70,598	23,514	0,30	220	1936-3
259	Gukkesjavri	Hammerfest	Finmark	70,618	23,820	0,18	303	1936-3
260	Dabmutjavri	Hammerfest	Finmark	70,647	23,943	0,23	236	1936-3
261	Bakketækjavn	Kvalsund	Finmark	70,462	23,576	0,63	136	1935-4
262	Øvre Saltvatnet	Kvalsund	Finmark	70,411	23,964	0,91	274	1935-4
263	Litle Havvatnet	Måsøy	Finmark	70,698	24,971	0,83	324	2036-3
264	Bahkajavri	Måsøy	Finmark	70,843	24,748	0,80	229	2036-4
265	Risvikvatnet	Måsøy	Finmark	70,909	24,896	0,52	170	2036-4
266	Cappesjavri	Nordkapp	Finmark	71,071	25,396	0,64	56	2037-2
267	Nedre Langvatnet	Nordkapp	Finmark	71,086	25,815	0,38	105	2037-2
268	Kaldfjordvatnet	Nordkapp	Finmark	71,109	25,909	0,28	106	2137-3
269	Russvikvatn	Nordkapp	Finmark	70,820	26,347	0,27	165	2136-4
270	Kjæsvatnet	Lebesby	Finmark	70,588	26,128	5,16	47	2136-3
271	Langvatnet	Gamvik	Finmark	70,957	27,916	2,05	193	2236-1
272	Koifjordvatnet	Gamvik	Finmark	70,943	28,155	2,21	31	2236-1
273	Suolojavri	Tana	Finmark	70,450	27,621	0,92	317	2235-4
274	Gålgutjavri	Tana	Finmark	70,344	28,003	1,06	95	2235-1
275	Baisjavri	Tana	Finmark	70,025	26,801	1,03	284	2135-2
276	Lævvajavri	Tana	Finmark	69,872	25,986	0,68	434	2134-4
277	Duolbajavri	Karasjok	Finmark	69,517	24,590	0,71	425	1934-2
278	Guotkujavrit	Kautokeino	Finmark	69,449	24,070	0,85	425	1933-1
279	Lavvojavri	Kautokeino	Finmark	68,950	23,655	1,61	476	1932-4
280	Avzejavri	Kautokeino	Finmark	68,900	23,355	1,81	361	1832-1
281	Davit Gåldinjavri	Kautokeino	Finmark	68,856	23,435	0,55	396	1932-4
282	Gavdnjajavri	Kautokeino	Finmark	68,752	24,552	3,84	444	1932-2
283	Ravdojavri	Kautokeino	Finmark	68,672	24,683	0,81	432	2032-3
284	Vuoååojavri	Porsanger	Finmark	70,018	24,823	1,24	291	2035-3
285	Syltevikvatnet	Båtsfjord	Finmark	70,535	30,394	0,66	21	2436-2
286	Oksevatn	Vardø	Finmark	70,347	30,884	2,73	143	2035-4
287	Kibergvatnet	Vardø	Finmark	70,311	30,994	0,27	42	2535-4
288	Skallnesvatnet	Vadsø	Finmark	70,142	30,255	0,20	108	2435-2
289	Langsmedvatnet	Vadsø	Finmark	70,090	29,920	1,34	61	2435-3
290	Skaidejavri	Sør-Varanger	Finmark	69,929	29,113	1,85	322	2334-1
291	Råtjern	Sør-Varanger	Finmark	69,875	29,188	0,70	264	2334-1
292	Vegvatnet	Sør-Varanger	Finmark	69,658	29,264	0,31	101	2334-2
293	Holmvatnet	Sør-Varanger	Finmark	69,706	29,721	0,92	146	2434-3
294	Bårsajavri	Sør-Varanger	Finmark	69,564	29,806	0,45	150	2434-3
295	Ulekristajavri	Sør-Varanger	Finmark	69,532	29,448	0,17	242	2434-3
296	Store Sametti	Sør-Varanger	Finmark	69,486	29,630	7,51	96	2433-4
297	Store Spurvvatnet	Sør-Varanger	Finmark	69,356	29,225	4,95	164	2333-1
298	Følvatnet	Sør-Varanger	Finmark	69,254	28,928	2,57	177	2333-1
299	Ellenvatnet	Sør-Varanger	Finmark	69,120	28,913	12,36	120	2333-2
300	Ødevatnet	Sør-Varanger	Finmark	69,067	28,992	2,83	88	2333-2
301	Andrevatn	Sør-Varanger	Finmark	69,699	30,033	1,88	46	2434-2
302	Langvatnet	Sør-Varanger	Finmark	69,730	30,188	0,32	90	2434-2
303	Litle Ropelvvatnet	Sør-Varanger	Finmark	69,757	30,198	1,17	52	2434-1
304	Dalvatn	Sør-Varanger	Finmark	69,694	30,368	0,23	132	2434-2
305	Rabbvatnet	Sør-Varanger	Finmark	69,653	30,459	0,38	83	2434-2
306	Hundvatnet	Sør-Varanger	Finmark	69,547	30,538	0,60	171	2434-2

307	Korpvatnet	Sør-Varanger	Finmark	69,587	30,851	1,00	197	2534-3
308	Store Skardvatnet	Sør-Varanger	Finmark	69,622	30,758	0,67	238	2534-3
309	St.Valvatnet	Sør-Varanger	Finmark	69,716	30,655	3,60	157	2534-3
310	Gardsjøen	Sør-Varanger	Finmark	69,705	30,846	0,71	82	2534-3
311	Litle Djupvatnet	Sør-Varanger	Finmark	69,706	30,589	0,40	211	2434-2
312	Langvatnet	Sør-Varanger	Finmark	69,722	30,587	0,80	87	2434-2
313	Gravsjøen	Sør-Varanger	Finmark	69,751	30,610	1,51	118	2434-2
316	Coalbmejavri	Sør-Varanger	Finmark	69,783	30,541	0,18	221	2434-1
319	Kjeftavatn	Nordkapp	Finmark	71,104	25,721	0,35	73	2037-2
320	Hestevatn	Måsøy	Finmark	70,952	24,664	0,59	45	2036-4
321	Glimmervatnet	Hammerfest	Finmark	70,660	23,785	0,53	232	1936-3
322	Langvatn	Hammerfest	Finmark	70,672	23,757	0,13	156	1936-3
323	Storvikvatn	Hammerfest	Finmark	70,687	23,962	0,64	28	1936-3
324	Holmvatn	Karlsøy	Troms	69,932	19,404	0,21	198	1534-1
325	Trolldalsvatnet	Moskenes	Nordland	67,910	12,914	1,25	152	1830-1
401	Ellasjøen		Bjørnøya	74,460	18,920	0,72	21	
402	Øyangen		Bjørnøya	74,550	18,900	0,35	32	
501	Arressjøen		Svalbard	79,673	10,802	0,20	10	
502	Barentsvatn		Svalbard	78,579	21,810	0,37	100	
503	Kongressvatn		Svalbard	78,010	13,965	0,50	95	
504	Linnèvatn		Svalbard	78,050	13,810	3,54	10	
505	Rickardvatn		Svalbard	79,759	12,361	3,04	20	
506	Åsøvatn		Svalbard	79,833	11,770	0,15	5	

8.2 Appendix 2: Metals in sediments

Concentrations (µg/g dw) of metals in surface sediment (0-0.5 cm), subsurface sediment (0.5-1.0 cm) and reference sediment in 122 lakes in Northern Norway and Svalbard.

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
194	Elgviddvatnet	0-0.5	9.244	0.222	5.545	0.757	0.208	16.753	64.772	38.641	0.100	0.928	66.000	72.626	0.134	2.154	1.767	0.103	0.473	82.696	0.496	123.938
194	Elgviddvatnet	0.5-1	8.000	.	.	.	.	.	.	.	0.120	.	.	.	.	.	.	.	.	.	.	.
194	Elgviddvatnet	ref	7.200	.	.	.	.	.	.	.	0.030	.	.	.	.	.	.	.	.	.	.	.
195	Øvre Sørvatn	0-0.5	37.745	0.347	19.606	0.781	0.395	8.572	35.218	22.503	0.200	4.444	20.606	119.698	0.483	7.836	2.781	0.105	0.298	51.598	0.227	74.279
195	Øvre Sørvatn	0.5-1	34.564	0.347	22.094	0.918	0.686	8.794	33.744	23.501	0.210	4.426	18.926	130.668	0.557	8.504	2.265	0.096	0.349	50.079	0.202	82.569
195	Øvre Sørvatn	ref	24.903	0.165	9.779	0.339	0.197	11.555	40.875	16.765	0.060	3.678	23.111	26.364	0.120	5.832	0.506	0.046	0.292	50.142	0.105	66.790
196	Krokvatnet	0-0.5	27.536	0.473	37.867	1.267	2.311	45.497	38.729	44.188	0.240	3.131	50.616	173.007	0.667	5.733	5.709	0.628	0.667	52.581	0.328	244.892
196	Krokvatnet	0.5-1	26.488	0.451	36.957	1.178	2.120	43.348	35.607	43.436	0.210	3.340	50.034	169.127	0.574	4.989	4.510	0.682	0.674	51.261	0.272	223.205
196	Krokvatnet	ref	17.895	0.295	37.005	0.269	1.018	44.661	41.817	43.568	0.080	2.734	39.527	19.743	0.066	6.027	0.337	0.265	0.601	48.923	0.180	163.558
197	Skittreskvatnet	0-0.5	13.619	0.351	57.381	0.532	1.510	32.315	33.296	65.409	0.140	6.918	39.015	63.651	0.279	2.200	1.443	0.152	0.365	60.520	0.215	153.748
197	Skittreskvatnet	0.5-1	11.940	0.306	53.539	0.516	0.959	29.007	33.158	61.460	0.110	6.004	32.541	59.177	0.226	1.897	1.234	0.151	0.285	62.942	0.189	140.474
197	Skittreskvatnet	ref	5.749	0.222	76.279	0.225	0.441	18.666	31.434	62.657	0.030	4.291	25.353	19.111	0.145	1.138	0.251	0.054	0.186	62.166	0.111	103.831
198	Langtjørna	0-0.5	15.816	0.378	18.868	0.737	0.781	13.143	41.590	50.753	0.100	2.452	31.487	83.927	0.215	2.197	1.320	0.031	0.235	49.709	0.270	117.046
198	Langtjørna	0.5-1	15.839	0.371	20.357	0.745	0.710	13.509	40.414	50.784	0.090	2.407	32.923	74.362	0.226	2.323	1.712	0.047	0.228	48.851	0.254	113.021
198	Langtjørna	ref	15.903	0.362	25.760	0.338	0.795	14.459	45.189	64.765	0.050	3.396	39.800	22.530	0.125	2.835	0.201	0.048	0.222	48.792	0.226	112.338
199	Gråvatnet	0-0.5	30.952	0.710	25.914	1.256	0.503	23.079	24.995	52.665	0.190	15.671	13.193	138.932	0.658	7.916	7.132	5.917	0.717	56.092	0.727	96.128
199	Gråvatnet	0.5-1	29.651	0.745	23.419	1.426	0.471	16.727	24.310	47.991	0.200	13.655	13.483	138.767	0.683	7.560	8.122	5.093	0.703	53.948	0.672	89.508
199	Gråvatnet	ref	6.049	0.193	4.049	0.133	0.130	16.458	19.288	38.893	0.040	5.291	15.674	15.973	0.087	1.725	0.655	0.408	0.551	60.742	0.445	68.001
202	Grønåsvatnet	0-0.5	25.472	0.148	4.645	0.346	0.490	15.372	45.948	28.644	0.110	1.254	26.209	33.437	0.128	3.056	0.735	0.153	0.461	53.728	0.465	120.579
202	Grønåsvatnet	0.5-1	20.800	.	.	.	.	.	.	.	0.110	.	.	.	.	.	.	.	.	.	.	.
202	Grønåsvatnet	ref	27.100	.	.	.	.	.	.	.	0.070	.	.	.	.	.	.	.	.	.	.	.
203	Markavatnet	0-0.5	17.917	0.246	4.047	0.563	1.349	22.868	61.243	53.305	0.100	3.968	51.783	53.252	0.230	3.286	1.012	0.754	1.050	84.529	0.621	155.239
203	Markavatnet	0.5-1	18.100	.	.	.	.	.	.	.	0.180	.	.	.	.	.	.	.	.	.	.	.
203	Markavatnet	ref	13.900	.	.	.	.	.	.	.	0.110	.	.	.	.	.	.	.	.	.	.	.
204	Storvikvatnet	0-0.5	16.854	0.305	5.712	0.767	1.224	30.345	35.106	32.767	0.133	12.336	36.246	96.258	0.216	2.816	1.620	0.422	0.795	61.683	0.413	154.341
204	Storvikvatnet	0.5-1	14.737	0.250	5.724	0.716	0.993	33.038	37.210	31.154	0.100	10.841	39.719	101.013	0.180	3.155	1.290	0.375	0.924	66.636	0.513	163.930
204	Storvikvatnet	ref	13.333	0.213	1.641	0.545	0.375	18.683	39.865	35.685	0.032	5.897	35.860	21.118	0.028	1.733	0.282	0.139	0.782	71.990	0.213	121.385
205	Straitasjavri	0-0.5	7.299	0.199	497.504	0.297	0.605	7.195	13.107	13.037	0.030	69.718	7.963	29.354	0.443	1.762	0.811	0.071	0.249	28.340	4.071	78.891
205	Straitasjavri	0.5-1	6.300	.	.	.	.	.	.	.	0.040	.	.	.	.	.	.	.	.	.	.	.
205	Straitasjavri	ref	2.100	.	.	.	.	.	.	.	0.003	.	.	.	.	.	.	.	.	.	.	.
206	Kjemåvatn	0-0.5	12.500	0.254	18.456	0.451	0.463	18.909	5.471	11.809	0.070	55.033	4.009	32.341	0.461	1.945	1.498	0.207	0.620	19.468	0.835	46.109
206	Kjemåvatn	0.5-1	8.716	0.244	20.085	0.406	0.323	15.351	4.983	10.562	0.050	45.202	3.387	24.981	0.444	1.625	1.480	0.120	0.358	19.488	0.692	41.581
206	Kjemåvatn	ref	5.192	0.241	14.182	0.280	0.254	4.689	5.656	10.380	0.020	29.805	3.397	11.795	0.304	1.480	0.517	0.024	0.351	18.448	0.693	43.681
207	Øvre Sølvbakk	0-0.5	19.638	0.612	14.193	0.652	0.152	6.630	41.113	93.203	0.150	6.066	21.285	46.450	0.242	6.595	1.939	0.158	0.389	48.428	0.512	63.903

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
207	Øvre Sølvbakk	0.5-1	19.200	.	.	.	.	.	.	.	0.110	.	.	.	.	.	.	.	.	.	.	.
207	Øvre Sølvbakk	ref	14.200	.	.	.	.	.	.	.	0.030	.	.	.	.	.	.	.	.	.	.	.
208	Fiskeløysvatnet	0-0.5	24.490	0.551	16.659	0.937	2.446	127.797	37.125	132.683	0.150	12.911	85.683	69.192	0.385	6.148	1.986	0.263	5.526	39.573	0.583	164.460
208	Fiskeløysvatnet	0.5-1	22.064	0.485	12.721	0.596	1.165	73.078	39.029	106.548	0.100	7.590	52.433	40.927	0.196	3.623	0.843	0.178	2.840	43.846	0.411	126.077
208	Fiskeløysvatnet	ref	19.011	0.570	10.424	0.277	2.489	50.010	49.784	136.792	0.060	12.863	109.308	18.066	0.059	11.290	0.195	0.135	2.244	52.342	0.531	155.247
210	Valnesvatnet	0-0.5	27.619	0.400	15.158	1.393	1.221	35.603	39.810	51.176	0.220	1.430	26.838	166.394	0.633	4.295	2.010	1.093	0.836	41.514	0.568	237.717
210	Valnesvatnet	0.5-1	26.900	.	.	.	.	.	.	.	0.200	.	.	.	.	.	.	.	.	.	.	.
210	Valnesvatnet	ref	37.500	.	.	.	.	.	.	.	0.170	.	.	.	.	.	.	.	.	.	.	.
211	Steigtindvatnet	0-0.5	34.756	0.590	17.759	1.480	0.839	42.638	85.548	72.456	0.320	3.451	93.335	164.812	0.698	7.264	3.892	1.094	1.222	61.545	0.363	192.019
211	Steigtindvatnet	0.5-1	30.077	0.596	18.914	1.428	0.657	37.071	80.284	55.471	0.280	3.206	77.315	166.416	0.718	6.582	3.881	1.199	1.073	52.521	0.301	147.017
211	Steigtindvatnet	ref	20.926	0.321	7.424	0.441	0.543	43.288	103.916	60.527	0.060	4.791	132.307	24.099	0.102	7.272	0.452	0.963	1.228	59.493	0.234	110.940
213	Trolltindvatnet	0-0.5	27.737	0.987	11.179	2.071	0.317	45.418	76.373	77.905	0.275	5.793	23.015	195.811	0.313	4.595	0.484	0.145	1.065	62.459	0.294	109.879
213	Trolltindvatnet	0.5-1	23.577	1.112	9.713	1.769	0.238	35.416	79.517	77.524	0.143	5.316	24.524	169.323	0.236	3.450	0.380	0.166	0.946	64.543	0.252	121.486
213	Trolltindvatnet	ref	15.166	0.746	1.697	0.681	0.474	25.974	83.556	98.982	0.082	9.462	25.258	32.862	0.022	3.939	0.098	-0.007	0.809	66.121	0.251	88.407
215	Tennvatn	0-0.5	41.327	0.575	15.635	0.950	0.462	8.883	10.265	17.620	0.280	32.636	6.587	84.584	0.731	7.885	6.047	0.262	0.249	23.650	0.669	68.435
215	Tennvatn	0.5-1	44.000	.	.	.	.	.	.	.	0.290	.	.	.	.	.	.	.	.	.	.	.
215	Tennvatn	ref	49.100	.	.	.	.	.	.	.	0.150	.	.	.	.	.	.	.	.	.	.	.
218	Kjerrvatn	0-0.5	35.616	0.842	23.712	1.437	1.072	34.357	19.343	30.375	0.220	38.991	11.487	137.582	0.863	14.041	7.157	3.168	3.226	40.076	0.638	168.453
218	Kjerrvatn	0.5-1	33.511	0.407	12.615	0.716	0.692	35.530	11.293	14.762	0.200	22.637	6.511	75.719	0.514	7.141	4.228	2.031	2.733	20.184	0.357	95.352
218	Kjerrvatn	ref	30.461	0.439	3.758	0.093	0.889	11.594	12.718	17.583	0.060	23.125	6.771	11.684	0.064	7.333	0.449	0.278	1.664	25.953	0.342	151.117
219	Kilvatnet	0-0.5	36.025	0.234	12.276	0.506	0.723	55.070	4.853	10.155	0.290	10.783	4.366	77.695	0.494	4.866	3.347	0.418	0.960	17.457	0.478	91.797
219	Kilvatnet	0.5-1	35.700	.	.	.	.	.	.	.	0.280	.	.	.	.	.	.	.	.	.	.	.
219	Kilvatnet	ref	41.900	.	.	.	.	.	.	.	0.110	.	.	.	.	.	.	.	.	.	.	.
222	Fageråvatnet	0-0.5	34.226	0.858	14.761	0.846	0.291	24.727	33.078	71.009	0.374	4.872	14.786	103.145	0.373	7.327	1.721	0.394	0.280	67.745	0.580	82.368
222	Fageråvatnet	0.5-1	35.429	0.846	18.748	0.860	0.217	19.992	32.943	60.955	0.354	4.464	13.321	106.159	0.371	7.517	2.967	0.281	0.227	64.196	0.563	72.384
222	Fageråvatnet	ref	39.732	0.734	7.828	0.086	0.353	29.050	29.698	62.949	0.206	5.625	14.407	9.869	0.043	10.110	0.056	0.069	0.344	65.192	0.499	63.566
223	Storvatn	0-0.5	23.737	0.293	14.142	0.817	0.662	122.945	14.384	28.066	0.208	2.207	13.790	131.970	0.408	5.571	3.078	3.058	0.575	45.381	0.330	67.271
223	Storvatn	0.5-1	25.926	0.339	13.328	1.098	1.256	136.720	17.078	30.327	0.258	2.281	19.024	163.884	0.438	6.572	2.442	1.702	0.986	52.748	0.354	95.151
223	Storvatn	ref	17.209	0.236	1.538	0.067	0.230	20.708	21.408	36.665	0.115	2.345	9.074	4.481	0.019	5.871	0.109	0.145	0.148	65.993	0.242	77.775
224	Vikvatnet	0-0.5	17.757	0.200	5.517	0.514	1.342	8.990	7.491	11.818	0.178	6.957	5.640	86.581	0.183	3.725	1.061	0.255	0.267	23.553	0.219	162.834
224	Vikvatnet	0.5-1	17.284	0.185	4.326	0.567	1.286	12.416	7.884	10.043	0.187	6.882	5.972	87.528	0.166	3.840	0.748	0.176	0.269	23.354	0.143	177.485
224	Vikvatnet	ref	19.231	0.104	0.785	0.036	0.595	7.539	5.527	7.484	0.102	6.145	3.720	4.407	0.014	3.062	0.018	0.034	0.127	16.764	0.085	88.653
225	Dalvatnet / Bøvatnet	0-0.5	10.949	0.175	2.911	0.208	0.654	16.191	28.765	21.963	0.138	8.612	19.658	35.069	0.106	1.847	0.154	0.271	0.418	45.918	0.090	109.718
225	Dalvatnet / Bøvatnet	0.5-1	8.591	0.127	2.795	0.198	0.597	20.067	29.636	24.343	0.100	10.080	21.749	33.828	0.107	1.568	0.131	0.258	0.436	49.038	0.083	123.226
225	Dalvatnet / Bøvatnet	ref	8.451	0.125	0.738	0.021	0.215	19.101	33.079	26.920	0.047	7.319	25.667	5.120	0.007	-0.113	0.123	0.050	0.399	51.874	0.070	110.013
226	Strumpvatnet	0-0.5	25.532	0.440	14.408	1.064	0.544	16.471	28.576	21.992	0.285	5.631	15.257	118.449	0.306	4.934	0.283	0.463	0.546	50.626	0.279	91.565
226	Strumpvatnet	0.5-1	16.500	0.259	14.421	0.721	0.397	13.817	24.553	13.504	0.176	4.158	14.406	102.945	0.215	2.907	0.214	0.339	0.467	40.031	0.192	78.133
226	Strumpvatnet	ref	14.035	0.179	6.261	0.065	0.116	15.569	25.603	16.649	0.056	2.544	17.133	33.172	0.018	0.308	0.098	0.069	0.435	47.808	0.141	77.083
227	Storvatn	0-0.5	26.776	0.249	30.547	0.572	1.299	35.677	27.772	14.737	0.450	35.552	14.574	92.491	0.297	4.200	2.897	0.538	0.408	48.245	2.769	122.787
227	Storvatn	0.5-1	52.113	0.231	33.371	0.713	1.288	30.667	32.081	15.729	0.307	33.368	14.195	114.543	0.317	4.558	3.246	0.294	0.371	53.916	2.445	136.135
227	Storvatn	ref	23.784	0.103	29.785	0.054	0.354	25.014	38.010	10.061	0.102	13.701	15.783	15.560	0.089	4.081	0.403	0.106	0.319	60.316	1.196	69.893
228	Løynvatn	0-0.5	20.755	0.555	6.130	1.038	1.721	26.879	13.048	23.866	0.220	11.384	9.393	154.360	0.224	4.787	2.366	0.264	0.335	23.404	0.636	95.894

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
228	Løynvatn	0.5-1	17.647	0.364	11.839	0.875	1.027	27.420	13.069	18.694	0.144	12.804	7.879	121.356	0.215	4.421	3.183	0.177	0.228	24.725	1.080	94.305
228	Løynvatn	ref	9.890	0.337	2.111	0.079	0.526	13.965	17.535	40.537	0.055	3.680	8.998	8.879	0.023	0.895	0.199	0.098	0.213	33.421	0.320	124.398
229	Trolldalsvatn (Rekvatn)	0-0.5	29.213	0.532	6.455	0.687	0.415	33.560	139.150	59.505	0.293	5.944	50.680	93.509	0.204	6.880	1.218	0.396	0.295	89.154	0.316	101.080
229	Trolldalsvatn (Rekvatn)	0.5-1	29.070	0.470	6.609	0.652	0.331	35.934	151.617	55.279	0.273	6.018	58.799	87.376	0.194	6.286	0.856	0.238	0.298	94.665	0.265	104.093
229	Trolldalsvatn	ref	15.574	0.403	0.580	0.038	0.178	36.830	139.397	64.234	0.135	7.572	64.613	4.284	0.003	1.513	0.228	0.107	0.201	87.011	0.147	108.097
231	Finnsætervatnet	0-0.5	32.850	0.548	5.914	0.638	0.354	16.280	51.101	32.807	0.233	7.838	12.431	75.165	0.202	4.167	0.173	0.405	0.772	52.845	0.260	64.491
231	Finnsætervatnet	0.5-1	31.098	0.525	5.414	0.555	0.236	16.513	51.916	29.284	0.203	7.500	12.240	66.649	0.159	3.840	0.108	0.293	0.685	53.617	0.221	66.663
231	Finnsætervatnet	ref	24.000	0.718	1.003	0.069	0.255	7.545	54.629	42.083	0.095	6.466	14.360	7.295	0.018	5.551	0.014	0.051	0.631	65.062	0.205	64.536
232	Storvatnet	0-0.5	27.273	0.332	6.258	0.454	1.249	30.755	44.020	31.206	0.164	29.880	24.567	75.053	0.221	4.754	1.787	0.404	0.668	61.903	0.472	97.403
232	Storvatnet	0.5-1	27.869	0.339	7.319	0.516	1.340	26.702	48.684	32.440	0.220	26.541	24.671	88.562	0.231	5.274	2.052	0.266	0.560	71.850	0.387	110.567
232	Storvatnet	ref	18.681	0.302	0.949	0.069	0.567	18.347	36.142	27.536	0.070	12.948	20.051	7.571	0.011	3.347	0.082	0.070	0.655	44.658	0.523	62.761
233	Sverigedalsvatnet	0-0.5	29.900	0.590	6.674	0.571	1.023	24.280	33.042	28.874	0.152	15.926	17.950	96.741	0.260	4.898	0.427	0.289	1.600	49.302	0.183	70.728
233	Sverigedalsvatnet	0.5-1	29.300	0.596	6.463	0.493	0.965	24.851	32.461	27.521	0.134	18.818	17.768	83.209	0.236	4.708	0.305	0.365	1.636	48.897	0.205	69.154
233	Sverigedalsvatnet	ref	22.300	0.518	1.044	0.048	0.852	22.051	33.846	26.822	0.005	19.914	22.825	4.708	0.011	5.796	0.083	0.083	1.218	51.793	0.109	52.185
234	Rundnakkvatnet	0-0.5	28.302	0.221	9.478	0.441	0.881	11.902	25.055	18.611	0.113	33.079	10.734	62.023	0.246	5.160	0.830	0.130	0.297	43.180	0.205	41.447
234	Rundnakkvatnet	0.5-1	27.273	0.171	5.996	0.452	0.695	10.056	27.500	17.754	0.096	26.955	11.230	67.240	0.264	4.856	0.365	0.097	0.313	42.736	0.191	50.617
234	Rundnakkvatnet	ref	25.743	0.137	0.754	0.050	0.282	5.622	23.893	18.646	0.039	13.832	12.619	7.811	0.013	2.193	0.009	0.023	0.438	39.006	0.056	30.673
235	Skøvatnet	0-0.5	15.217	0.574	8.053	0.627	1.674	54.547	55.419	79.031	0.190	2.691	63.640	83.688	0.347	4.603	1.893	1.397	1.341	80.971	0.419	196.432
235	Skøvatnet	0.5-1	19.000	.	.	.	.	.	.	.	0.180	.	.	.	.	.	.	.	.	.	.	.
235	Skøvatnet	ref	16.700	.	.	.	.	.	.	.	0.030	.	.	.	.	.	.	.	.	.	.	.
236	Kapervann	0-0.5	28.977	0.238	1.173	0.134	0.579	3.405	22.186	28.464	0.091	33.640	9.251	23.364	0.060	5.097	0.027	0.045	0.176	40.511	0.093	34.048
236	Kapervann	0.5-1	30.172	0.199	1.007	0.120	0.442	3.963	23.120	27.586	0.098	36.965	9.585	20.773	0.052	6.160	-0.012	0.048	0.173	46.522	0.102	37.432
236	Kapervann	ref	27.861	0.348	0.870	0.066	0.380	5.928	27.895	41.010	0.103	62.845	12.783	10.039	0.011	8.959	0.015	0.061	0.399	50.724	0.136	66.008
237	Øvre Kaperdalsvatn	0-0.5	25.566	0.370	4.340	0.443	0.592	22.958	74.153	111.210	0.239	33.182	30.805	52.890	0.075	5.531	0.731	0.460	0.631	75.832	0.312	57.050
237	Øvre Kaperdalsvatn	0.5-1	28.261	0.316	4.587	0.385	0.485	19.889	62.463	89.568	0.183	39.422	25.590	44.492	0.086	6.469	1.639	0.366	0.436	66.273	0.371	51.652
237	Øvre Kaperdalsvatn	ref	20.330	0.294	0.877	0.099	0.264	14.883	73.951	110.961	0.095	30.631	35.171	12.018	0.008	5.377	0.024	0.065	0.605	84.927	0.307	64.347
238	Kapervatnet	0-0.5	31.481	0.317	6.815	0.623	0.435	55.645	54.894	98.306	0.170	35.167	22.390	73.413	0.295	8.712	1.510	0.435	1.019	67.758	0.391	63.230
238	Kapervatnet	0.5-1	29.749	0.324	6.999	0.587	0.413	57.288	47.361	83.261	0.170	38.742	17.989	67.396	0.351	7.895	1.630	0.846	1.024	60.745	0.360	53.301
238	Kapervatnet	ref	16.953	0.423	1.196	0.070	0.451	34.053	65.562	103.434	0.070	52.682	23.797	17.975	0.032	8.988	0.375	0.226	0.788	77.056	0.500	65.443
239	Storvatnet	0-0.5	32.906	0.186	2.453	0.289	0.246	15.113	57.257	61.917	0.197	4.197	39.082	39.339	0.129	4.645	0.581	0.123	0.111	46.995	0.172	34.152
239	Storvatnet	0.5-1	30.263	0.138	1.809	0.304	0.196	16.602	67.928	60.272	0.153	3.299	44.057	41.846	0.113	4.744	0.190	0.082	0.103	51.601	0.143	36.225
239	Storvatnet	ref	27.719	0.141	0.686	0.053	0.235	16.645	45.769	85.202	0.056	5.286	38.414	4.300	0.006	4.469	-0.003	0.032	0.265	55.683	0.105	37.035
240	Øvre Vasskardvatnet	0-0.5	11.957	0.217	1.823	0.200	0.337	24.131	31.869	62.831	0.055	10.335	15.635	14.009	0.035	1.173	0.066	0.103	0.247	61.212	0.117	93.064
240	Øvre Vasskardvatnet	0.5-1	11.159	0.146	1.426	0.143	0.208	17.623	29.485	45.020	0.018	8.580	13.545	9.037	0.020	0.452	0.035	0.097	0.175	53.451	0.100	70.777
240	Øvre Vasskardvatnet	ref	8.257	0.128	2.413	0.111	0.195	44.843	25.504	79.791	0.035	16.770	13.449	4.543	0.016	-1.538	0.050	0.062	0.168	49.996	0.321	80.200
241	Aslatjavri	0-0.5	14.706	0.643	3.718	0.502	0.756	18.001	72.484	47.246	0.087	1.739	48.986	44.996	0.068	2.412	0.388	0.057	0.604	73.045	0.111	122.828
241	Aslatjavri	0.5-1	11.940	0.298	3.352	0.480	0.676	19.875	72.568	49.660	0.081	2.227	48.169	39.376	0.056	2.144	0.353	0.079	0.584	73.728	0.100	133.505
241	Aslatjavri	ref	10.837	0.291	3.375	0.226	0.488	18.424	73.280	48.356	0.029	1.951	49.641	14.296	0.013	0.536	0.119	0.051	0.732	76.656	0.063	114.585
242	Storvatnet	0-0.5	9.019	0.260	31.991	0.244	0.721	43.069	92.639	113.991	0.070	3.476	87.740	24.101	0.126	2.070	0.837	0.265	0.535	81.938	0.149	130.142
242	Storvatnet	0.5-1	7.900	.	.	.	.	.	.	.	0.070	.	.	.	.	.	.	.	.	.	.	.

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
242	Storvatnet	ref	7.600	.	.	.	.	.	.	.	0.030	.	.	.	.	.	.	.	.	.	.	.
243	Tårnvatnet	0-0.5	17.634	0.296	8.053	0.606	0.914	43.912	76.254	75.286	0.110	2.821	66.177	70.000	0.175	3.143	1.289	0.385	6.199	106.857	0.231	216.851
243	Tårnvatnet	0.5-1	17.195	0.283	8.263	0.622	0.648	40.649	73.449	70.132	0.110	2.487	65.548	70.241	0.144	2.804	1.291	0.416	1.423	103.389	1.664	196.573
243	Tårnvatnet	ref	11.005	0.324	19.021	0.441	0.718	36.338	78.835	76.514	0.050	2.987	65.754	34.832	0.068	2.602	0.889	0.178	0.852	112.306	0.468	184.905
244	Store Synnfjordvatnet	0-0.5	26.045	0.979	5.154	0.558	0.513	231.266	68.416	332.494	0.170	12.542	39.127	58.465	0.231	5.789	0.979	1.155	1.224	91.663	0.828	95.821
244	Store Synnfjordvatnet	0.5-1	21.500	.	.	.	.	.	.	.	0.220	.	.	.	.	.	.	.	.	.	.	.
244	Store Synnfjordvatnet	ref	14.800	.	.	.	.	.	.	.	0.040	.	.	.	.	.	.	.	.	.	.	.
245	Peder Sørensensvatn	0-0.5	23.618	0.409	4.731	0.329	1.099	117.165	41.670	64.601	0.182	6.596	48.999	78.197	0.157	7.076	0.667	0.315	1.221	58.272	0.153	145.444
245	Peder Sørensensvatn	0.5-1	24.615	0.334	4.011	0.270	0.661	273.610	37.622	53.201	0.155	6.725	38.525	59.908	0.159	6.601	0.939	0.290	0.902	51.684	0.172	126.992
245	Peder Sørensensvatn	ref	19.369	0.825	1.702	0.054	0.620	46.778	67.372	111.249	0.125	5.085	50.935	111.970	0.028	8.623	0.101	0.556	0.747	83.495	0.236	191.496
247	Botnvatnet	0-0.5	17.544	0.453	253.031	0.407	0.233	41.001	29.242	146.067	0.100	14.800	27.134	37.182	0.349	3.455	0.591	0.402	0.400	88.473	0.250	111.977
247	Botnvatnet	0.5-1	15.139	0.437	515.791	0.405	0.185	29.034	30.412	146.237	0.090	10.551	27.142	35.005	0.192	3.947	0.508	0.245	0.367	99.930	0.221	114.087
247	Botnvatnet	ref	9.070	0.452	62.334	0.081	0.228	25.204	30.516	149.553	0.030	9.012	29.494	8.776	0.082	3.085	0.106	0.055	0.378	101.744	0.207	126.244
248	Langfjordvatnet	0-0.5	25.513	0.334	16.583	0.501	0.283	79.087	34.767	54.643	0.100	3.864	21.450	38.504	0.193	7.663	2.240	1.106	1.112	55.872	0.308	56.122
248	Langfjordvatnet	0.5-1	23.500	.	.	.	.	.	.	.	0.100	.	.	.	.	.	.	.	.	.	.	.
248	Langfjordvatnet	ref	14.100	.	.	.	.	.	.	.	0.030	.	.	.	.	.	.	.	.	.	.	.
250	Josvatnet	0-0.5	9.231	0.368	249.386	0.143	1.269	17.261	72.842	43.939	0.065	67.400	45.212	9.607	0.094	1.294	0.354	0.054	0.700	71.082	0.574	72.946
250	Josvatnet	0.5-1	9.150	0.190	296.515	0.145	0.875	17.766	75.087	42.205	0.067	57.882	49.038	9.502	0.080	1.425	0.404	0.069	0.581	76.910	0.672	76.981
250	Josvatnet	ref	5.422	0.188	15.568	0.154	0.176	18.671	81.445	53.703	0.018	2.997	50.757	8.147	0.031	-0.853	0.362	0.053	0.591	78.782	0.188	74.701
251	Cearpmatjavri	0-0.5	12.202	0.334	4.851	0.155	0.226	30.763	42.764	184.237	0.094	6.300	30.723	12.783	0.037	2.802	0.079	0.060	0.202	60.661	0.326	47.637
251	Cearpmatjavri	0.5-1	12.598	0.170	4.152	0.133	0.196	32.085	44.834	175.903	0.100	5.646	32.520	10.769	0.020	2.397	0.047	0.045	0.213	62.279	0.252	49.995
251	Cearpmatjavri	ref	6.473	0.596	6.286	0.110	0.307	30.903	68.859	346.373	0.034	3.700	53.368	9.803	0.011	3.249	0.360	0.039	0.611	91.152	0.063	92.459
252	Junttejavri	0-0.5	7.407	0.130	1.673	0.139	0.154	8.805	31.227	12.224	0.041	1.728	16.107	10.228	0.036	0.826	0.112	-0.006	0.341	48.915	0.127	46.753
252	Junttejavri	0.5-1	7.362	0.048	1.560	0.131	0.158	8.597	30.282	11.239	0.030	1.884	15.308	10.007	0.023	0.877	0.065	0.001	0.332	48.402	0.128	43.631
252	Junttejavri	ref	5.836	0.069	0.827	0.060	0.056	8.749	29.007	11.942	0.026	1.131	14.636	3.978	0.014	-0.910	0.075	0.003	0.339	47.904	0.078	42.621
253	Bjørndalvatna	0-0.5	14.329	0.194	5.989	0.299	0.281	28.709	49.309	55.033	0.139	4.075	100.112	29.020	0.068	3.349	0.197	0.079	0.155	58.656	0.378	73.363
253	Bjørndalvatna	0.5-1	11.483	0.076	5.473	0.210	0.278	40.605	53.680	53.215	0.055	3.960	108.621	21.673	0.043	2.548	0.246	0.096	0.155	60.602	0.296	76.299
253	Bjørndalvatna	ref	7.887	0.119	2.794	0.043	0.142	36.911	49.803	69.607	0.042	3.577	113.286	2.806	0.007	1.085	0.093	0.023	0.146	56.576	0.436	69.644
254	Låvtajavri	0-0.5	18.487	0.507	13.696	0.360	0.326	21.613	49.879	54.355	0.102	7.915	44.266	31.094	0.067	1.860	0.052	0.077	0.485	56.110	0.582	80.409
254	Låvtajavri	0.5-1	17.333	0.228	12.545	0.200	0.215	22.486	49.506	52.039	0.107	6.669	49.285	21.216	0.033	1.210	0.030	0.073	0.433	57.776	0.518	82.725
254	Låvtajavri	ref	10.980	0.666	15.646	0.123	0.084	15.556	75.846	75.454	0.120	2.789	50.812	5.973	0.029	-0.402	0.092	0.079	0.387	56.659	2.233	87.729
256	Hesteskovatnet	0-0.5	13.636	0.231	1.838	0.194	0.488	40.108	22.430	45.399	0.068	11.995	34.342	17.532	0.039	1.973	0.539	0.090	0.053	71.469	0.257	54.044
256	Hesteskovatnet	0.5-1	11.528	0.067	1.671	0.187	0.304	27.622	25.807	48.741	0.069	6.984	37.646	17.744	0.030	1.383	0.258	0.048	0.048	78.391	0.170	57.566
256	Hesteskovatnet	ref	9.661	0.082	0.563	0.031	0.134	23.644	27.553	53.780	0.020	2.649	35.067	1.592	0.006	0.565	0.010	0.012	0.038	91.837	0.188	48.159
257	Langvatnet	0-0.5	35.714	0.556	12.011	0.901	1.427	120.020	22.849	74.707	0.190	10.104	62.333	89.167	0.415	7.695	1.328	0.434	6.960	40.824	0.568	163.726
257	Langvatnet	0.5-1	33.761	0.599	12.760	0.922	1.110	190.882	21.517	68.615	0.190	10.398	40.272	77.928	0.392	7.491	1.725	0.479	6.699	37.574	0.469	140.286
257	Langvatnet	ref	27.500	0.635	5.272	0.203	0.805	77.806	27.756	108.309	0.070	10.922	46.884	10.568	0.082	9.324	0.232	0.118	4.782	45.207	0.539	260.698
258	Langvatnet	0-0.5	29.630	0.359	11.818	0.663	1.481	100.511	46.401	82.824	0.160	5.251	53.053	72.767	0.268	6.676	0.847	0.601	1.734	37.528	0.354	138.502
258	Langvatnet	0.5-1	28.148	0.330	9.814	0.571	1.550	126.818	43.061	75.448	0.140	4.970	68.428	55.560	0.274	6.387	0.717	0.830	1.729	35.380	0.284	148.511
258	Langvatnet	ref	17.742	0.459	4.110	0.126	1.023	111.935	67.485	108.989	0.050	3.947	76.808	6.902	0.038	8.270	0.119	0.235	1.662	43.563	0.271	240.531
259	Gukkesjavri	0-0.5	22.059	0.539	77.772	0.438	0.534	8.280	26.105	43.478	0.149	28.180	18.437	26.246	0.062	4.353	0.139	0.052	0.431	42.549	1.358	67.632
259	Gukkesjavri	0.5-1	14.286	0.297	50.521	0.379	0.393	8.792	28.413	42.815	0.114	30.850	17.831	17.985	0.033	3.463	0.077	0.023	0.426	43.621	1.026	76.474

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
259	Gukkesjavri	ref	11.111	0.559	36.707	0.416	0.158	12.292	37.258	73.277	0.063	22.996	25.881	12.652	0.008	1.616	0.069	0.034	0.542	57.498	0.961	96.099
260	Dabmutjavri	0-0.5	33.607	0.952	8.637	0.490	0.413	4.862	18.246	55.342	0.208	17.677	17.259	37.872	0.171	5.903	0.276	0.106	0.300	27.993	0.998	54.561
260	Dabmutjavri	0.5-1	28.022	0.570	6.569	0.439	0.401	5.187	17.502	51.037	0.191	18.406	17.502	33.011	0.148	6.478	0.127	0.059	0.291	28.861	1.089	59.306
260	Dabmutjavri	ref	25.641	0.701	5.657	0.257	0.324	8.085	22.482	66.540	0.085	21.473	24.582	12.390	0.019	4.924	0.066	0.036	0.453	35.237	1.069	92.198
261	Bakketækjavn	0-0.5	32.000	0.428	7.760	0.341	0.532	89.476	30.008	101.267	0.110	3.332	21.419	248.301	0.199	5.694	0.617	0.158	5.130	30.203	1.039	99.569
261	Bakketækjavn	0.5-1	30.935	0.307	13.096	0.188	0.182	115.143	22.001	42.732	0.070	4.454	15.573	19.331	0.132	5.520	0.526	0.100	0.447	22.713	1.464	70.109
261	Bakketækjavn	ref	27.652	0.307	12.524	0.370	0.239	29.258	49.143	25.673	0.080	3.618	29.597	42.960	0.163	1.638	1.075	0.086	0.291	69.897	0.209	87.126
262	Øvre Saltvatnet	0-0.5	16.667	0.755	6.279	0.257	0.236	35.263	208.206	145.674	0.156	4.309	56.962	23.040	0.074	1.922	0.079	0.142	0.368	72.324	0.121	54.133
262	Øvre Saltvatnet	0.5-1	14.118	0.405	6.225	0.182	0.219	35.579	218.461	139.352	0.136	4.203	58.357	15.687	0.047	1.483	0.029	0.185	0.308	73.051	0.079	54.766
262	Øvre Saltvatnet	ref	12.211	1.343	8.808	0.129	0.353	30.834	258.992	288.527	0.214	6.273	66.282	7.988	0.012	1.189	0.041	0.142	0.456	86.782	0.105	58.072
263	Litle Havvatnet	0-0.5	25.000	0.812	29.741	0.642	0.254	7.030	16.668	22.980	0.197	8.401	11.638	53.338	0.148	3.526	0.095	0.180	0.392	29.622	0.517	48.782
263	Litle Havvatnet	0.5-1	20.313	0.343	26.895	0.444	0.160	7.258	16.366	21.103	0.139	8.221	10.662	39.361	0.115	2.950	0.046	0.105	0.371	27.572	0.423	48.008
263	Litle Havvatnet	ref	5.224	0.659	5.216	0.263	0.030	13.313	24.455	31.814	0.039	1.080	18.778	25.519	0.023	-0.351	0.173	0.038	0.581	36.074	0.127	74.384
264	Bahkajavri	0-0.5	20.667	0.527	2.707	0.846	1.148	14.301	90.956	35.975	0.173	1.101	50.492	78.747	0.120	3.052	0.407	0.127	0.748	90.115	0.686	143.900
264	Bahkajavri	0.5-1	19.128	0.246	2.773	0.793	0.924	14.637	96.947	32.927	0.133	1.223	50.495	73.313	0.127	3.094	0.404	0.140	0.683	93.305	0.591	140.254
264	Bahkajavri	ref	18.644	0.236	1.489	0.333	0.664	16.699	111.262	38.968	0.043	1.479	54.708	22.142	0.014	1.378	0.227	0.067	0.679	108.175	0.637	127.922
265	Risvikvatnet	0-0.5	31.579	0.737	34.374	0.429	0.310	13.341	16.439	58.331	0.178	12.414	11.149	34.115	0.202	8.778	1.090	0.258	0.238	21.039	0.211	40.771
265	Risvikvatnet	0.5-1	32.450	0.408	26.617	0.399	0.275	12.643	17.000	57.325	0.148	12.301	11.859	31.134	0.136	7.990	0.883	0.152	0.230	22.367	0.163	45.516
265	Risvikvatnet	ref	26.891	0.588	6.873	0.264	0.312	14.050	26.275	117.258	0.083	7.555	21.700	10.121	0.023	8.768	0.036	0.032	0.682	31.334	0.145	81.070
266	Cappesjavri	0-0.5	30.380	1.157	18.263	0.655	0.941	22.838	26.807	32.083	0.301	16.944	10.755	59.332	0.276	5.456	0.103	0.760	1.264	26.835	0.230	55.573
266	Cappesjavri	0.5-1	29.444	0.520	17.917	0.538	1.013	78.768	23.144	27.673	0.224	20.217	10.519	49.429	0.238	4.866	0.099	1.302	1.497	28.187	0.247	60.077
266	Cappesjavri	ref	22.599	0.806	20.095	0.146	0.722	16.235	35.496	35.403	0.121	16.194	9.943	10.157	0.061	5.879	0.021	0.156	0.658	34.047	0.159	55.318
267	Nedre Langvatnet	0-0.5	18.391	0.516	96.660	0.356	0.708	354.890	30.184	41.686	0.123	14.487	47.093	36.557	0.176	4.400	0.106	0.278	1.863	37.689	0.726	97.330
267	Nedre Langvatnet	0.5-1	22.069	0.206	105.640	0.270	0.461	261.600	29.368	38.142	0.059	16.424	42.967	27.565	0.152	4.047	0.066	0.255	1.109	38.143	0.633	87.274
267	Nedre Langvatnet	ref	15.528	0.412	64.217	0.122	0.268	79.656	36.173	55.217	0.090	8.292	66.598	4.974	0.191	1.874	0.013	0.019	0.485	51.056	1.119	102.938
268	Kaldfjordvatnet	0-0.5	29.167	0.799	83.106	0.567	2.237	192.134	19.197	27.953	0.344	50.516	22.242	57.919	0.252	7.634	0.217	0.328	1.865	32.565	1.504	55.993
268	Kaldfjordvatnet	0.5-1	29.412	0.408	98.206	0.417	0.876	78.013	16.813	24.020	0.123	38.602	14.498	36.230	0.221	7.909	0.563	0.236	0.621	28.602	0.216	45.951
268	Kaldfjordvatnet	ref	25.294	0.547	35.544	0.153	0.627	9.168	22.412	33.392	0.067	36.629	15.993	5.061	0.041	7.124	0.007	0.036	0.301	35.024	0.198	51.716
269	Russvikvatn	0-0.5	15.723	0.282	4.803	0.157	0.304	9.783	36.938	13.273	0.046	3.166	17.851	22.378	0.061	1.996	0.028	0.010	0.373	56.424	0.049	54.231
269	Russvikvatn	0.5-1	10.753	0.133	3.843	0.123	0.280	9.249	38.416	11.797	0.090	3.439	17.060	17.891	0.049	1.727	0.000	0.012	0.351	56.376	0.050	53.227
269	Russvikvatn	ref	15.126	0.274	4.688	0.055	0.282	7.298	31.130	17.067	0.024	4.971	13.349	8.230	0.058	0.701	0.006	0.007	0.313	53.436	0.046	58.526
270	Kjæsvatnet	0-0.5	18.878	0.560	17.608	0.457	1.281	18.536	30.798	23.077	0.197	2.136	17.846	41.683	0.224	3.886	0.162	0.302	0.672	39.326	0.245	111.478
270	Kjæsvatnet	0.5-1	15.714	0.273	14.082	0.379	0.904	14.704	27.498	17.795	0.120	1.715	14.812	34.917	0.182	2.657	0.139	0.220	0.499	34.111	0.138	96.166
270	Kjæsvatnet	ref	8.156	0.292	91.620	0.154	0.512	10.958	28.529	18.687	0.044	1.651	12.576	11.866	0.054	0.264	0.197	0.083	0.378	35.746	0.100	83.221
271	Langvatnet	0-0.5	13.889	0.508	41.624	0.604	1.700	15.998	12.689	19.341	0.164	17.726	14.189	67.117	0.213	4.503	0.178	0.133	0.696	20.637	0.193	82.688
271	Langvatnet	0.5-1	14.013	0.244	29.220	0.517	1.631	13.530	13.021	16.953	0.089	15.319	12.564	56.573	0.155	4.498	0.094	0.094	0.559	20.445	0.130	85.741
271	Langvatnet	ref	13.878	0.230	15.967	0.165	0.812	11.398	12.880	18.537	0.040	16.855	11.992	16.301	0.040	3.068	0.005	0.047	0.570	20.093	0.095	73.848
272	Koifjordvatnet	0-0.5	12.889	0.538	8.138	0.485	1.236	15.818	16.125	18.890	0.169	5.181	31.997	40.944	0.165	2.484	0.141	0.167	0.848	26.527	0.104	103.100
272	Koifjordvatnet	0.5-1	13.092	0.224	8.918	0.439	0.905	22.763	14.479	15.435	0.108	11.333	26.722	35.697	0.144	2.270	0.214	0.215	0.939	24.412	0.087	101.099
272	Koifjordvatnet	ref	7.120	0.309	5.728	0.237	0.334	20.803	19.853	22.051	0.035	2.574	19.964	13.136	0.051	1.244	0.112	0.040	0.639	28.859	0.045	77.235
273	Suolojavri	0-0.5	17.431	0.723	11.622	0.509	0.442	17.329	22.929	38.339	0.119	1.729	18.789	55.286	0.110	1.678	0.102	0.136	0.220	19.693	0.093	67.110
273	Suolojavri	0.5-1	15.745	0.352	9.322	0.416	0.354	15.686	22.779	32.562	0.081	1.713	16.325	39.737	0.095	1.129	0.059	0.127	0.163	17.880	0.042	63.655

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
273	Suolojavri	ref	9.859	0.518	6.596	0.224	0.115	7.689	24.317	47.316	0.068	0.739	17.012	23.638	0.035	0.466	0.028	0.115	0.139	19.218	0.039	61.613
274	Gålgutjavri	0-0.5	23.853	0.344	30.820	0.295	1.085	21.277	22.714	28.539	0.238	22.688	23.986	28.762	0.205	3.501	0.380	0.186	0.279	37.679	0.180	145.952
274	Gålgutjavri	0.5-1	24.000	0.210	34.102	0.239	1.046	27.955	20.953	23.991	0.191	24.293	21.808	23.757	0.176	3.305	0.495	0.113	0.241	36.017	0.171	140.386
274	Gålgutjavri	ref	26.738	0.295	28.168	0.054	0.533	16.753	37.567	43.288	0.119	6.772	25.872	5.365	0.045	4.563	0.061	0.036	0.274	60.944	0.125	182.061
275	Baisjavri	0-0.5	17.619	0.228	2.202	0.226	1.451	31.133	20.815	23.775	0.138	37.116	30.208	19.208	0.118	1.446	0.507	0.080	0.226	32.037	0.137	103.468
275	Baisjavri	0.5-1	16.379	0.104	1.312	0.208	1.472	16.149	24.035	26.957	0.095	26.440	23.913	17.977	0.084	1.666	0.379	0.057	0.131	35.921	0.065	91.205
275	Baisjavri	ref	13.287	0.181	0.350	0.028	0.815	8.623	30.844	31.101	0.052	8.585	16.806	3.821	0.009	0.985	0.019	0.043	0.212	42.694	0.059	117.176
276	Lævvajavri	0-0.5	14.235	0.144	0.626	0.089	0.358	12.221	38.154	16.780	0.030	1.304	30.392	14.464	0.027	0.557	0.068	0.001	0.080	44.098	0.044	83.919
276	Lævvajavri	0.5-1	41.473	0.045	0.363	0.062	0.306	9.875	33.791	12.720	0.033	0.995	24.663	10.355	0.018	0.465	0.057	0.014	0.060	36.466	0.036	73.760
276	Lævvajavri	ref	2.793	0.032	0.004	0.008	0.061	12.630	27.364	9.711	0.008	0.567	19.322	4.558	0.004	-1.258	0.035	-0.001	0.039	28.573	0.007	54.897
277	Duolbajavri	0-0.5	23.121	0.201	1.429	0.331	0.591	9.389	23.163	21.127	0.092	8.683	13.785	28.866	0.113	1.122	0.081	0.034	0.145	38.370	0.130	72.456
277	Duolbajavri	0.5-1	25.000	0.086	1.405	0.295	0.537	7.470	22.817	18.066	0.081	7.989	12.239	25.814	0.114	1.161	0.090	0.023	0.131	37.159	0.090	65.896
277	Duolbajavri	ref	13.462	0.107	0.292	0.026	0.202	6.566	24.321	18.333	0.018	11.222	11.037	2.227	0.004	-0.645	0.001	0.003	0.140	36.764	0.046	52.525
278	Guotkujavrit	0-0.5	34.076	0.162	1.274	0.216	0.432	4.284	22.778	18.075	0.048	3.750	16.461	14.874	0.065	0.867	0.066	0.014	0.129	29.500	0.315	35.326
278	Guotkujavrit	0.5-1	32.022	0.067	1.009	0.201	0.374	3.844	22.365	15.608	0.073	3.789	15.901	12.988	0.051	0.649	0.083	0.020	0.120	27.887	0.280	34.624
278	Guotkujavrit	ref	21.118	0.054	0.412	0.073	0.161	4.185	24.614	18.626	0.028	7.811	13.956	2.514	0.008	-0.811	0.002	0.001	0.116	34.402	0.294	40.376
279	Lavvojavri	0-0.5	20.000	0.253	1.811	0.249	0.428	8.281	47.627	16.957	0.110	1.288	20.539	18.292	0.095	0.873	0.115	0.041	0.125	52.968	0.105	48.497
279	Lavvojavri	0.5-1	22.293	0.063	1.738	0.253	0.419	8.185	51.847	17.770	0.100	1.375	20.623	17.679	0.094	0.970	0.112	0.049	0.126	54.358	0.096	51.513
279	Lavvojavri	ref	17.130	0.039	0.377	0.027	0.157	7.677	52.338	20.189	0.032	1.820	18.925	2.872	0.009	-0.728	0.007	0.008	0.108	57.190	0.045	41.372
280	Avzejavri	0-0.5	27.308	0.193	9.716	0.181	1.691	42.727	23.427	18.666	0.323	57.762	25.062	12.719	0.094	3.431	0.472	0.137	0.339	83.822	1.249	86.984
280	Avzejavri	0.5-1	27.559	0.087	16.395	0.215	1.269	42.507	27.282	19.991	0.333	35.699	25.405	15.398	0.103	4.132	0.558	0.125	0.230	96.771	1.457	94.897
280	Avzejavri	ref	21.081	0.104	3.802	0.071	0.454	34.703	48.450	40.249	0.107	5.249	31.210	5.454	0.010	2.120	0.156	0.036	0.374	126.077	0.309	93.957
281	Davit Gåldinjavri	0-0.5	43.503	0.303	2.385	0.445	0.667	4.088	34.463	21.011	0.142	0.911	17.251	36.608	0.218	1.777	0.056	0.020	0.118	43.580	0.174	47.982
281	Davit Gåldinjavri	0.5-1	40.234	0.132	2.298	0.493	0.659	4.062	35.976	20.522	0.152	0.907	16.109	35.910	0.186	1.746	0.056	0.034	0.118	44.035	0.112	59.959
281	Davit Gåldinjavri	ref	46.597	0.080	0.500	0.041	0.207	3.533	46.108	30.990	0.073	0.638	16.852	2.893	0.015	0.204	-0.004	0.011	0.080	40.895	0.035	31.518
282	Gavdnjajavri	0-0.5	25.490	0.329	3.646	0.539	1.556	24.015	35.011	17.168	0.251	21.643	21.681	37.168	0.173	1.398	0.480	0.089	0.860	89.561	0.660	132.540
282	Gavdnjajavri	0.5-1	22.286	0.111	2.698	0.397	1.119	25.334	35.367	13.849	0.152	20.946	21.023	27.233	0.121	1.206	0.220	0.054	0.704	86.881	0.534	131.225
282	Gavdnjajavri	ref	20.388	0.097	0.926	0.143	0.499	11.268	38.101	55.388	0.060	18.665	16.380	3.353	0.010	-0.588	0.028	0.007	0.256	91.651	0.609	110.074
283	Ravdojavri	0-0.5	22.222	0.184	7.503	0.632	0.937	20.127	57.025	40.804	0.116	44.638	24.582	43.495	0.136	2.667	0.179	0.138	0.601	93.362	0.560	68.363
283	Ravdojavri	0.5-1	20.096	0.182	6.521	0.622	0.932	26.367	49.159	38.158	0.084	46.802	21.975	35.603	0.120	2.266	0.201	0.144	0.600	80.264	0.557	53.458
283	Ravdojavri	ref	16.327	0.192	1.510	0.185	0.519	13.829	66.573	56.511	0.047	34.253	18.716	3.554	0.017	2.648	0.060	0.041	0.481	111.563	0.427	69.603
284	Vuoååojavri	0-0.5	20.482	0.106	2.524	0.229	0.412	9.220	25.671	17.210	0.039	0.324	20.610	24.052	0.044	1.276	0.141	0.797	0.198	28.179	0.032	2.253
284	Vuoååojavri	0.5-1	18.041	0.114	2.067	0.289	0.341	8.132	26.656	16.888	0.046	0.279	18.613	25.052	0.051	1.478	0.146	0.813	0.164	28.373	0.024	2.243
284	Vuoååojavri	ref	15.723	0.086	1.474	0.107	0.340	7.819	27.566	16.064	0.009	0.278	16.567	9.751	0.019	1.058	0.065	0.946	0.187	28.595	0.007	2.507
285	Syltevikvatnet	0-0.5	21.000	0.222	24.682	0.254	0.422	10.420	25.076	20.215	0.097	4.214	23.970	21.667	0.126	5.265	0.185	0.093	0.203	49.946	0.075	63.635
285	Syltevikvatnet	0.5-1	21.212	0.202	28.532	0.265	0.425	9.529	22.325	19.276	0.061	3.894	21.321	21.298	0.125	5.236	0.198	0.076	0.191	43.836	0.075	54.529
285	Syltevikvatnet	ref	18.491	0.259	36.262	0.143	0.224	11.271	24.801	20.345	0.020	5.477	17.787	9.810	0.086	4.842	0.067	0.039	0.177	48.151	0.051	57.809
286	Oksevatn	0-0.5	16.026	0.247	22.839	1.040	2.131	20.817	26.631	51.687	0.116	2.031	70.086	93.005	0.252	3.745	0.418	0.362	0.528	42.850	0.228	102.147
286	Oksevatn	0.5-1	16.783	0.198	20.544	1.010	2.002	20.741	23.408	39.859	0.069	1.945	52.379	84.828	0.227	3.338	0.521	0.336	0.513	36.441	0.187	89.218
286	Oksevatn	ref	6.438	0.160	3.524	0.154	0.288	19.433	28.362	21.701	0.014	0.795	22.627	11.679	0.037	1.683	0.146	0.055	0.212	37.724	0.036	66.942
287	Kibergvatnet	0-0.5	23.950	0.112	9.327	0.218	0.458	9.002	28.188	23.709	0.090	1.696	35.767	19.123	0.090	1.110	0.062	0.092	0.196	43.292	0.108	71.624
287	Kibergvatnet	0.5-1	22.692	0.168	10.807	0.242	0.531	8.704	26.297	24.824	0.097	1.566	33.282	17.825	0.076	1.265	0.077	0.088	0.180	40.005	0.131	67.627

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
287	Kibergvatnet	ref	21.630	0.143	8.394	0.136	0.356	7.752	24.963	12.958	0.059	1.488	15.366	14.085	0.061	0.790	0.054	0.029	0.172	33.099	0.087	61.362
288	Skallnesvatnet	0-0.5	36.364	0.313	9.099	0.566	0.368	6.011	16.876	45.265	0.107	0.837	44.755	50.385	0.138	2.732	0.270	0.136	0.259	29.430	0.106	58.732
288	Skallnesvatnet	0.5-1	32.973	0.332	8.240	0.617	0.398	4.763	15.918	43.462	0.104	0.816	38.173	47.397	0.127	2.848	0.201	0.116	0.259	28.147	0.106	54.169
288	Skallnesvatnet	ref	21.333	0.263	1.884	0.188	0.249	7.468	17.742	21.677	0.038	0.719	21.453	20.078	0.026	1.572	0.033	0.025	0.293	28.132	0.042	70.154
289	Langsmedvatnet	0-0.5	37.037	0.358	14.877	0.481	1.300	11.838	17.163	30.333	0.143	3.021	46.946	56.551	0.253	3.003	0.489	0.188	0.354	24.915	0.147	143.595
289	Langsmedvatnet	0.5-1	33.131	0.352	14.465	0.491	1.323	11.448	15.773	30.368	0.083	2.741	44.894	51.469	0.249	3.084	0.443	0.187	0.344	23.820	0.169	136.139
289	Langsmedvatnet	ref	17.881	0.225	6.249	0.105	0.503	52.751	11.693	13.187	0.031	2.540	54.703	14.714	0.037	1.943	0.039	0.062	1.085	16.692	0.030	103.426
290	Skaidejavri	0-0.5	21.429	0.206	9.667	0.559	1.884	50.367	22.942	58.055	0.113	12.695	28.755	62.975	0.187	3.672	0.385	0.273	0.678	27.627	0.242	104.274
290	Skaidejavri	0.5-1	20.000	0.219	6.699	0.487	1.500	57.952	22.061	59.156	0.076	8.590	24.761	48.411	0.143	3.020	0.183	0.201	0.933	26.814	0.182	91.432
290	Skaidejavri	ref	19.578	0.239	0.886	0.070	0.474	21.867	36.264	89.799	0.035	6.004	16.502	4.858	0.013	3.625	0.005	0.090	0.480	31.963	0.168	58.954
291	Råtjern	0-0.5	32.474	0.337	8.028	0.528	0.239	16.811	41.571	89.040	0.086	5.403	17.078	37.975	0.143	3.660	0.027	0.202	0.554	25.987	0.212	53.579
291	Råtjern	0.5-1	34.454	0.317	5.883	0.402	0.235	14.737	37.358	88.993	0.074	4.898	13.168	30.771	0.102	3.222	0.034	0.167	0.498	24.232	0.144	47.979
291	Råtjern	ref	18.831	0.368	2.483	0.084	0.310	12.044	61.363	215.093	0.050	4.320	20.977	8.632	0.024	3.273	0.018	0.072	0.626	36.141	0.291	50.136
292	Vegvatnet	0-0.5	27.885	0.298	4.133	0.300	0.524	40.501	33.098	101.311	0.175	21.225	18.835	30.919	0.120	3.132	0.189	0.377	0.261	30.480	0.308	73.543
292	Vegvatnet	0.5-1	28.177	0.333	3.501	0.283	0.477	35.310	32.144	110.985	0.167	16.079	19.272	28.437	0.116	3.423	0.078	0.264	0.346	29.012	0.361	82.008
292	Vegvatnet	ref	29.518	0.649	1.707	0.084	0.911	42.227	49.033	159.315	0.201	37.063	20.296	10.037	0.026	5.569	0.290	0.158	0.367	52.817	0.628	215.325
293	Holmvatnet	0-0.5	30.986	0.409	8.187	0.479	0.337	20.880	43.815	94.726	0.171	5.850	36.372	42.803	0.140	4.083	0.100	0.259	0.480	33.742	0.318	78.815
293	Holmvatnet	0.5-1	30.736	0.350	5.750	0.343	0.287	20.564	43.953	89.140	0.121	5.911	22.663	33.065	0.105	3.433	0.071	0.192	0.432	32.612	0.293	71.732
293	Holmvatnet	ref	26.907	0.609	3.782	0.133	0.321	23.571	41.113	221.940	0.144	13.319	12.320	8.864	0.024	0.352	0.185	0.076	0.229	38.063	0.805	44.282
294	Bårsajavri	0-0.5	33.533	0.393	15.463	0.747	0.544	22.593	22.248	92.437	0.235	12.285	68.695	56.848	0.366	3.859	1.784	0.327	0.083	45.281	0.658	79.869
294	Bårsajavri	0.5-1	37.984	0.490	10.074	0.709	0.690	15.196	21.107	84.723	0.224	12.161	55.195	50.851	0.318	3.740	1.557	0.221	0.095	45.366	0.641	78.633
294	Bårsajavri	ref	40.000	0.474	2.144	0.113	0.520	10.270	29.748	85.044	0.112	15.144	13.670	3.515	0.016	3.768	0.058	0.044	0.302	59.955	0.633	112.226
295	Ulekristajavri	0-0.5	20.690	0.265	8.239	0.346	2.558	236.618	33.476	97.650	0.197	156.718	68.360	38.786	0.179	2.949	0.941	0.195	2.124	48.799	3.559	168.167
295	Ulekristajavri	0.5-1	20.000	0.298	4.814	0.240	1.536	136.630	31.878	98.391	0.195	132.843	49.497	23.612	0.117	2.192	0.580	0.109	0.891	41.508	3.013	164.877
295	Ulekristajavri	ref	26.786	0.573	1.255	0.084	1.343	52.701	39.109	109.562	0.114	55.395	31.842	9.193	0.015	3.730	0.076	0.053	1.539	35.135	1.055	171.738
296	Store Sametti	0-0.5	23.649	0.454	10.863	0.534	0.711	27.880	31.357	115.464	0.171	8.862	56.293	48.176	0.190	3.096	0.212	0.275	0.559	34.752	0.500	79.844
296	Store Sametti	0.5-1	22.594	0.437	8.718	0.466	0.542	22.921	28.980	101.395	0.187	8.012	39.250	38.730	0.161	2.829	0.174	0.191	0.381	33.637	0.443	72.329
296	Store Sametti	ref	2.921	0.193	1.750	0.119	0.094	12.977	46.827	88.427	0.002	1.153	32.848	6.426	0.008	0.916	0.253	0.031	0.215	66.084	0.091	69.900
297	Store Spurvvatnet	0-0.5	17.730	0.517	4.838	0.406	4.018	80.171	41.880	149.461	0.153	28.080	180.353	39.982	0.157	2.522	0.236	0.155	2.170	36.029	1.349	323.728
297	Store Spurvvatnet	0.5-1	19.355	0.583	4.338	0.376	4.387	75.535	39.856	168.152	0.122	28.411	183.409	33.587	0.135	2.537	0.216	0.154	2.245	34.313	1.428	314.625
297	Store Spurvvatnet	ref	6.073	0.684	3.213	0.379	0.660	27.551	56.130	410.756	0.249	9.979	114.686	31.577	0.010	0.277	0.104	0.099	0.366	70.515	4.148	286.755
298	Følvatnet	0-0.5	25.000	0.307	5.468	0.442	0.524	23.364	24.320	74.154	0.111	6.322	19.376	39.561	0.177	2.200	0.078	0.112	0.834	26.533	0.319	55.970
298	Følvatnet	0.5-1	26.897	0.342	5.027	0.423	0.472	19.921	22.948	79.660	0.102	6.041	16.680	37.695	0.163	2.109	0.085	0.103	0.701	24.668	0.353	51.804
298	Følvatnet	ref	15.476	0.522	1.555	0.167	0.733	10.577	49.307	250.692	0.096	14.414	22.522	4.087	0.016	1.387	0.043	0.047	1.297	49.170	1.366	121.480
299	Ellenvatnet	0-0.5	32.203	0.403	5.473	0.790	0.875	9.979	32.603	77.400	0.247	8.295	62.416	77.871	0.246	2.985	0.818	0.285	0.223	44.979	0.801	129.712
299	Ellenvatnet	0.5-1	33.648	0.393	5.690	0.951	0.829	10.304	31.478	75.486	0.309	8.432	49.225	84.903	0.285	3.390	0.980	0.260	0.184	46.061	0.943	115.323
299	Ellenvatnet	ref	30.189	0.320	0.713	0.054	0.366	5.200	38.961	73.196	0.095	9.676	15.574	3.415	0.010	2.106	0.013	0.039	0.177	49.358	0.823	93.769
300	Ødevatnet	0-0.5	25.000	0.155	6.708	0.190	0.665	26.516	40.130	43.698	0.158	21.824	58.598	14.170	0.077	1.369	0.533	0.178	0.252	49.533	0.257	90.592
300	Ødevatnet	0.5-1	23.030	0.142	11.275	0.198	0.552	23.067	33.957	41.311	0.093	29.272	48.026	14.875	0.077	1.699	0.516	0.150	0.197	43.532	0.390	77.345
300	Ødevatnet	ref	12.658	0.246	1.888	0.074	0.243	25.649	68.802	54.621	0.060	6.568	42.990	7.647	0.006	1.145	0.144	0.031	0.331	79.384	0.113	99.681
301	Andrevatn	0-0.5	6.757	0.217	6.635	0.280	0.325	22.921	84.314	94.207	0.084	1.279	85.897	26.177	0.023	0.407	0.425	0.133	0.404	105.031	0.257	169.471
301	Andrevatn	0.5-1	6.296	0.225	6.262	0.293	0.322	24.818	79.943	96.417	0.041	1.510	81.248	30.742	0.025	0.485	0.415	0.155	0.416	99.054	0.224	153.094

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
301	Andrevatn	ref	6.278	0.212	2.492	0.172	0.164	23.305	78.566	63.459	0.013	1.221	50.697	13.029	0.008	0.217	0.286	0.055	0.355	100.921	0.075	111.639
302	Langvatnet	0-0.5	34.940	0.416	11.586	0.584	0.631	173.337	36.258	119.677	0.299	4.856	111.250	48.009	0.290	4.240	1.814	0.470	0.431	38.672	0.307	61.711
302	Langvatnet	0.5-1	33.704	0.448	9.876	0.509	0.557	118.986	30.298	92.671	0.272	5.146	73.809	39.549	0.234	3.986	1.487	0.328	0.292	33.260	0.261	55.320
302	Langvatnet	ref	28.251	0.426	2.015	0.073	0.410	26.237	45.524	71.081	0.129	5.887	20.051	4.691	0.013	4.237	0.042	0.054	0.309	44.395	0.165	82.006
303	Litle Ropelvvatnet	0-0.5	23.176	0.262	8.828	0.440	0.411	35.583	64.663	95.003	0.139	3.053	66.238	49.550	0.099	3.436	0.185	0.290	0.581	66.128	0.302	155.663
303	Litle Ropelvvatnet	0.5-1	21.849	0.269	6.330	0.310	0.377	33.068	66.005	80.867	0.096	2.845	51.086	35.372	0.067	2.813	0.142	0.230	0.544	66.369	0.245	151.206
303	Litle Ropelvvatnet	ref	19.014	0.382	8.814	0.098	0.376	62.029	74.847	87.280	0.065	4.728	34.062	15.172	0.018	0.762	0.295	0.434	0.496	71.390	0.354	154.900
304	Dalvatn	0-0.5	39.645	0.468	15.008	0.621	0.466	52.042	40.310	171.093	0.227	6.445	97.728	49.367	0.234	5.443	0.188	0.400	0.587	33.144	0.396	81.674
304	Dalvatn	0.5-1	34.483	0.425	13.446	0.556	0.445	49.202	35.635	155.492	0.224	7.145	80.695	44.126	0.205	5.545	0.205	0.365	0.560	32.033	0.372	78.204
304	Dalvatn	ref	32.126	1.088	1.638	0.093	0.539	16.685	65.139	268.154	0.172	4.172	25.681	13.540	0.018	4.613	0.000	0.103	0.433	45.624	0.526	78.757
305	Rabbvatnet	0-0.5	29.944	0.371	4.862	0.491	0.568	12.595	51.067	142.296	0.270	3.182	110.818	43.230	0.143	3.111	0.078	0.269	0.155	42.354	0.269	93.632
305	Rabbvatnet	0.5-1	29.787	0.359	4.208	0.424	0.623	10.480	43.851	112.958	0.196	3.068	87.867	41.336	0.130	3.121	0.075	0.176	0.154	39.046	0.228	90.555
305	Rabbvatnet	ref	29.255	0.316	1.632	0.039	0.344	8.130	49.010	59.176	0.039	4.124	20.766	4.741	0.012	2.019	0.003	0.017	0.137	45.453	0.098	98.418
306	Hundvatnet	0-0.5	35.570	0.478	21.810	0.633	1.415	26.361	75.297	260.108	0.358	25.109	348.014	46.373	0.191	5.668	0.657	0.862	0.162	85.884	0.505	146.900
306	Hundvatnet	0.5-1	33.495	0.430	15.586	0.471	1.115	17.606	73.603	168.029	0.282	24.406	202.389	41.463	0.133	5.623	0.319	0.397	0.148	91.725	0.446	146.280
306	Hundvatnet	ref	30.319	0.344	5.149	0.033	0.567	7.145	69.821	71.477	0.086	14.113	17.779	2.943	0.023	3.289	-0.001	0.014	0.126	79.921	0.254	118.057
307	Korpvatnet	0-0.5	34.532	0.220	7.548	0.326	0.613	23.202	42.542	345.893	0.162	1.057	456.113	20.386	0.083	1.787	0.167	0.429	0.101	37.194	0.247	48.181
307	Korpvatnet	0.5-1	31.250	0.261	7.441	0.356	0.688	21.506	40.190	375.499	0.156	1.146	419.131	20.244	0.080	2.090	0.146	0.408	0.111	36.754	0.207	49.767
307	Korpvatnet	ref	22.973	0.077	0.972	0.039	0.197	6.219	39.331	18.328	0.022	1.146	17.971	5.352	0.017	0.703	0.011	0.008	0.083	42.450	0.072	47.206
308	Store Skardvatnet	0-0.5	22.959	0.199	3.803	0.402	0.989	8.280	49.134	83.747	0.129	2.024	106.807	38.672	0.150	2.531	0.051	0.166	0.139	53.797	0.223	64.888
308	Store Skardvatnet	0.5-1	25.281	0.239	7.252	0.484	0.867	9.404	43.685	107.507	0.139	2.613	111.826	40.860	0.149	3.005	0.076	0.281	0.146	57.628	0.284	68.345
308	Store Skardvatnet	ref	18.857	0.216	1.633	0.048	0.308	4.953	48.132	26.419	0.083	2.990	18.361	4.982	0.020	2.029	-0.004	0.035	0.087	63.984	0.248	62.610
309	St.Valvatnet	0-0.5	10.860	0.287	9.252	0.367	0.298	32.560	72.033	117.331	0.136	1.789	87.367	34.503	0.048	1.811	0.214	0.215	0.308	57.635	0.168	85.308
309	St.Valvatnet	0.5-1	14.124	0.307	6.749	0.292	0.273	31.713	72.387	96.659	0.093	2.035	61.838	27.562	0.047	1.583	0.120	0.158	0.295	51.861	0.143	86.453
309	St.Valvatnet	ref	15.244	0.342	4.063	0.072	0.269	40.259	66.514	131.605	0.043	3.297	44.741	12.611	0.021	0.316	0.053	0.077	0.254	48.778	0.135	108.342
310	Gardsjøen	0-0.5	27.564	0.309	16.541	0.520	0.419	154.722	49.342	153.210	0.221	5.680	176.824	44.565	0.224	4.495	1.483	0.534	0.168	50.952	0.384	82.541
310	Gardsjøen	0.5-1	28.000	0.321	17.924	0.535	0.635	107.434	52.599	140.816	0.212	6.546	160.912	43.095	0.192	4.566	1.399	0.395	0.144	53.066	0.334	86.388
310	Gardsjøen	ref	27.311	0.295	2.421	0.041	0.626	29.663	58.948	56.468	0.072	6.630	29.293	5.508	0.022	3.199	0.058	0.040	0.401	58.489	0.213	106.720
311	Litle Djupvatnet	0-0.5	14.943	0.207	5.524	0.180	0.424	188.060	30.689	76.224	0.082	10.436	61.849	21.672	0.097	4.885	0.017	0.098	0.866	21.533	0.093	60.346
311	Litle Djupvatnet	0.5-1	17.757	0.234	5.022	0.187	0.423	132.121	31.295	77.871	0.065	9.934	47.462	21.451	0.089	5.500	0.022	0.081	0.766	21.808	0.104	54.555
311	Litle Djupvatnet	ref	15.347	0.940	10.324	0.063	0.696	17.279	77.985	296.136	0.086	6.699	70.937	92.208	0.021	3.322	0.016	0.055	0.433	64.334	0.187	246.877
312	Langvatnet	0-0.5	27.128	0.421	7.063	0.363	0.407	55.772	63.868	114.583	0.162	2.846	61.232	41.613	0.111	2.854	0.092	0.238	0.505	41.514	0.211	116.591
312	Langvatnet	0.5-1	25.180	0.477	5.320	0.271	0.386	54.714	66.765	107.681	0.149	3.038	45.251	35.017	0.095	2.664	0.070	0.184	0.477	40.375	0.180	115.487
312	Langvatnet	ref	19.075	0.567	3.123	0.042	0.406	30.955	78.445	111.686	0.130	2.360	28.201	27.054	0.021	2.559	0.032	0.126	0.382	45.733	0.200	159.388
313	Gravsjøen	0-0.5	29.825	0.670	14.488	0.938	0.387	42.357	78.452	176.984	0.287	1.730	86.210	71.195	0.193	5.573	0.166	0.390	0.611	35.245	0.374	113.009
313	Gravsjøen	0.5-1	28.994	0.656	11.655	0.782	0.365	36.926	72.683	144.763	0.212	1.598	58.912	63.869	0.180	5.163	0.152	0.382	0.636	32.542	0.336	103.870
313	Gravsjøen	ref	21.930	0.601	2.284	0.042	0.345	25.965	81.364	123.974	0.140	2.262	22.277	11.627	0.020	3.287	0.101	0.226	0.345	38.833	0.269	84.658
316	Coalbmejavri	0-0.5	32.381	0.567	17.036	0.991	1.148	170.400	61.455	128.403	0.332	8.102	151.201	76.553	0.290	6.712	1.517	1.645	1.142	37.562	0.323	137.110
316	Coalbmejavri	0.5-1	33.077	0.615	10.792	0.698	0.625	96.893	60.220	94.568	0.244	7.893	62.506	60.027	0.186	6.157	1.174	0.870	0.512	35.842	0.226	94.961
316	Coalbmejavri	ref	29.091	0.863	5.087	0.069	0.763	25.426	88.723	130.604	0.149	6.035	42.637	31.589	0.024	6.865	0.021	0.118	0.922	52.812	0.160	197.338
319	Kjeftavatn	0-0.5	16.000	0.435	3.715	0.654	0.720	10.830	52.853	36.019	0.104	1.952	33.690	64.133	0.086	4.721	0.442	0.124	0.399	90.431	1.647	111.881
319	Kjeftavatn	0.5-1	17.200	0.383	3.071	0.640	0.672	9.819	49.116	30.687	0.095	1.956	29.159	60.771	0.097	3.736	0.370	0.121	0.430	81.401	1.280	103.664

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
319	Kjeftavatn	ref	21.200	0.238	1.405	0.161	0.331	8.010	39.633	23.355	-0.006	1.879	21.643	5.415	0.028	3.231	0.104	0.041	0.365	59.128	0.744	61.868
320	Hestevatn	0-0.5	23.400	0.813	13.468	0.606	0.335	25.576	55.816	40.628	0.173	2.819	30.822	54.089	0.134	3.607	0.547	0.193	0.828	76.836	0.194	119.981
320	Hestevatn	0.5-1	21.200	0.866	14.450	0.580	0.323	23.268	56.972	40.785	0.146	3.039	31.617	51.248	0.110	3.517	0.268	0.224	0.887	79.773	0.182	121.567
320	Hestevatn	ref	15.000	0.905	12.381	0.238	0.275	25.092	56.523	41.700	0.064	3.180	32.735	15.278	0.029	4.071	0.172	0.161	0.901	80.274	0.167	102.500
321	Glimmervatnet	0-0.5	20.213	0.229	28.820	0.511	0.504	49.994	52.043	30.255	0.112	6.270	31.483	38.761	0.132	3.140	0.275	0.193	0.974	70.773	0.204	112.047
321	Glimmervatnet	0.5-1	21.371	0.233	37.282	0.539	0.427	57.471	47.504	32.106	0.112	6.441	29.050	37.634	0.131	4.148	0.396	0.192	0.839	62.747	0.190	100.212
321	Glimmervatnet	ref	12.105	0.371	13.292	0.357	0.261	20.718	62.724	50.381	0.084	3.942	38.083	12.660	0.019	2.126	0.164	0.058	0.844	72.210	0.407	137.893
322	Langvatn	0-0.5	42.308	0.289	3.649	0.374	0.404	10.921	23.472	41.793	0.139	6.000	14.476	49.261	0.130	5.929	0.380	0.977	0.267	56.836	0.058	1.837
322	Langvatn	0.5-1	41.176	0.313	2.664	0.405	0.728	10.961	24.965	46.114	0.142	4.586	15.221	46.372	0.189	5.949	0.372	0.893	0.290	61.361	0.025	1.635
322	Langvatn	ref	31.982	0.428	1.311	0.077	0.448	22.337	23.729	73.547	0.046	8.477	18.631	2.121	0.021	6.425	0.072	2.984	0.672	42.660	0.059	4.268
323	Storvikvatn	0-0.5	22.383	0.366	12.256	0.462	0.364	38.623	38.235	35.682	0.141	3.970	26.837	34.772	0.068	5.050	0.530	2.804	0.930	68.313	0.306	3.979
323	Storvikvatn	0.5-1	16.781	0.281	11.281	0.407	0.575	83.733	36.664	33.938	0.121	4.325	29.150	26.971	0.063	3.559	0.485	2.725	1.333	67.430	0.301	3.698
323	Storvikvatn	ref	11.111	0.616	10.483	0.352	0.259	42.349	41.326	55.814	0.061	2.205	34.077	14.053	0.022	2.178	0.363	4.885	0.888	74.058	0.251	6.800
324	Holmvatn	0-0.5	20.863	0.224	76.215	0.289	1.428	26.427	20.969	46.940	0.107	14.915	20.602	34.882	0.255	5.756	0.632	0.237	0.104	69.515	0.310	107.653
324	Holmvatn	0.5-1	20.530	0.242	85.995	0.361	1.594	32.703	25.133	52.843	0.134	21.809	22.381	46.948	0.307	5.601	0.878	0.276	0.148	81.664	0.358	127.024
324	Holmvatn	ref	14.373	0.337	44.181	0.102	1.181	34.264	43.503	89.626	0.074	8.993	31.602	1.975	0.098	12.422	0.181	0.535	0.126	122.394	0.561	135.058
325	Trolldalsvatnet	0-0.5	11.905	0.329	7.542	0.479	0.436	35.627	25.399	46.916	0.163	4.386	15.804	70.086	0.115	2.833	0.337	0.483	0.364	72.796	0.627	85.697
325	Trolldalsvatnet	0.5-1	13.057	0.336	7.694	0.557	0.400	36.981	28.683	47.310	0.134	4.721	15.534	82.654	0.122	2.945	0.437	0.390	0.366	76.658	0.664	93.660
325	Trolldalsvatnet	ref	10.811	0.228	0.866	0.085	0.144	13.040	23.288	40.755	0.047	3.309	14.466	11.497	0.014	1.673	0.048	0.039	0.177	82.486	0.533	81.650
401	Ellasjøen	0-0,5	27.3	0.231	13.237	0.293	2.806	45.211	7.341	35.113	0.116	0.884	43.821	69.695	0.043	3.564	0.071	0.447	0.480	14.454	0.044	0.873
401	Ellasjøen	0-0,5	27.3	0.231	13.237	0.293	2.806	45.211	7.341	35.113	0.116	0.884	43.821	69.695	0.043	3.564	0.071	0.447	0.480	14.454	0.044	0.873
401	Ellasjøen	0,5-1,0	10.0	0.221	10.458	0.321	2.620	65.664	7.935	35.550	0.097	0.649	53.094	72.542	0.044	3.567	0.070	0.446	0.542	15.387	0.053	0.877
401	Ellasjøen	ref	9.2	0.208	8.141	0.290	1.118	8.915	8.074	26.877	0.049	0.658	14.000	61.416	0.022	1.596	0.030	0.353	0.412	14.244	0.003	0.642
501	Arressjøen	0-0,5	25.4	0.658	7.853	0.683	0.884	8.485	17.002	43.149	0.424	4.954	12.647	45.888	0.031	7.253	0.392	0.820	0.374	45.835	4.450	2.249
501	Arressjøen	0,5-1,0	36.7	0.708	11.154	0.833	1.513	12.031	18.717	53.908	0.595	8.111	13.895	49.906	0.029	8.975	0.294	1.003	0.449	52.308	6.903	2.667
501	Arressjøen	ref	17.3	0.460	5.211	0.573	0.983	6.568	15.488	33.805	0.148	9.126	10.503	32.246	0.009	4.805	0.423	1.037	0.368	49.742	2.200	2.533
502	Barentsvatn	0-0,5	10.8	0.391	9.260	0.199	0.663	19.042	19.181	235.476	0.048	4.276	31.676	14.100	0.070	2.561	0.196	0.974	0.753	100.208	0.026	1.935
502	Barentsvatn	0,5-1,0	10.8	0.460	12.634	0.198	0.757	20.043	20.038	254.771	0.050	5.955	33.784	13.714	0.122	2.830	0.184	0.978	0.800	97.653	0.023	1.963
502	Barentsvatn	ref	12.4	0.531	13.257	0.190	0.904	16.321	21.806	253.166	0.042	5.142	32.335	11.903	0.051	3.487	0.140	1.001	0.866	103.573	0.023	2.096
503	Kongressvatn	0-0,5	6.5	0.134	2.046	0.161	0.559	5.832	23.125	9.052	0.012	3.358	14.612	15.228	0.028	2.616	0.242	0.269	0.233	28.206	0.023	0.576
503	Kongressvatn	0,5-1,0	7.2	0.135	2.077	0.160	0.570	6.251	23.408	9.210	0.015	3.774	15.850	14.910	0.028	2.336	0.170	0.266	0.245	27.736	0.020	0.559
503	Kongressvatn	ref	16.2	0.086	5.233	0.081	0.354	4.929	20.770	7.142	-0.014	2.710	12.361	4.935	0.049	1.492	0.105	0.234	0.191	24.069	0.005	0.545
504	Linnèvatn	0-0,5	9.4	0.139	12.778	0.296	0.199	17.452	19.404	37.054	0.034	0.881	30.584	25.685	0.022	0.843	0.098	0.514	0.338	32.229	0.001	0.899
504	Linnèvatn	0,5-1,0	10.0	0.141	12.269	0.350	0.204	16.467	17.415	35.642	0.037	0.724	29.538	25.300	0.029	0.700	0.041	0.522	0.311	28.581	-0.001	0.943
504	Linnèvatn	ref	8.4	0.133	11.715	0.339	0.179	17.896	17.067	35.078	0.025	0.663	31.515	24.312	0.022	0.522	0.112	0.536	0.292	28.134	-0.004	0.892
505	Rickardvatn	0-0,5	8.5	0.127	9.499	0.332	0.292	28.695	64.811	86.053	0.092	0.932	52.109	28.879	0.072	1.351	0.485	1.062	0.385	97.224	0.084	2.697
505	Rickardvatn	0,5-1,0	6.5	0.144	9.350	0.270	0.255	29.262	62.201	82.888	0.051	0.847	49.854	24.234	0.061	0.957	0.385	1.152	0.390	92.743	0.094	2.817
505	Rickardvatn	ref	5.3	0.152	9.624	0.359	0.200	22.993	48.608	56.983	-0.007	1.616	38.333	22.792	0.026	0.127	0.325	1.083	0.399	66.703	0.052	2.400
506	Åsøvatn	0-0,5	57.7	0.384	6.085	0.381	3.733	7.150	16.519	45.389	0.189	2.255	15.613	24.825	0.055	8.576	0.178	0.998	0.290	33.910	0.328	1.834
506	Åsøvatn	0,5-1,0	64.1	0.380	5.314	0.386	3.479	7.446	16.270	46.655	0.205	2.037	15.961	27.004	0.038	7.458	0.201	1.013	0.298	34.149	0.343	1.917

Number	Station name	layer	LOI %	Ag	As	Bi	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Te	Tl	V	W	Zn
506	Åsøvatn	ref	39.4	0.437	3.897	0.372	2.277	7.933	20.847	54.927	0.095	1.735	19.287	19.375	0.005	7.977	0.186	1.196	0.379	37.717	0.300	2.176

8.3 Appendix 3: PAH in sediments

Unilab ANALYSE A.S
Polarmiljøsenteret, 9296 TROMSØ
Foretaksnr.: NO 950 614 110 MVA
Tel: 77 75 03 50
Fax: 77 75 03 01

ANALYSE RAPPORT

NORSK AKKREDITERING TEST 081

Kunde: Akvaplan-niva as
Kunde referanse: AMAP
Kontaktperson: Guttorm Christensen
Adresse: Polarmiljøsenteret
Postnr./sted: 9296 Tromsø
Tel: 77 75 03 30
Fax: 77 75 03 01

Dato: 26.02.2007

Rapport nr.: UA636. PAH-s, TOM-s
Analyseparameter(e): PAH-16EPA, glødetap
Kontaktperson: Linda Hanssen

Analyseansvarlig: Linda Hanssen (sign.)

Underskriftsberettiget: Hanne Foshaug (sign.)

Prøvene ble levert ved Unilab Analyse AS av oppdragsgiver, og merket som angitt i tabellen nedenfor.

Prøve id. Unilab	Kundens id.	Matrix	Prøvens beskaffenhet ved mottak	Mottatt Unilab	Analyseperiode
636/1	Peder S. vann (0-1 cm)	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/2	221 Rundajavri mengdelsvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/3	221 Rundajavri mengdelsvatn, 1-2 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/4	222 Fageråvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/5	225 Dalvatn/Bøvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/6	226 strumpvatnet, 1-2 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/7	228 Laynv, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/8	229 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/9	231, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07

Prøve id. Unilab	Kundens id.	Matrix	Prøvens beskaffenhet ved mottak	Mottatt Unilab	Analyseperiode
636/10	233 sociged, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/11	234 Rundnakkv, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/12	235 Skøvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/13	236 Kapev, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/14	239 Storv., 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/15	240, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/16	242 Storvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/17	247 Botuvatn	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/18	248 Langfjordvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/19	250 Josvatn, Troms, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/20	251 Cearpm., 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/21	252 Junettejavri, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/22	254 LÅVTAJ. 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/23	256 Hesteskov., 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/24	259 Gukkesjavri, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/25	260 Dabmutjavri, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/26	264 Bahkajavri, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/27	265 Risvikvatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/28	266 Cappegj. PAH 0-1	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/29	268 Kaldfjordvatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/30	269 Russevikvatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/31	272 Koifjordvatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/32	279 Layvojavri, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/33	280 Avrejavri, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/34	282 Gaudjeg, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/35	283 Raudvj., 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07

Prøve id. Unilab	Kundens id.	Matrix	Prøvens beskaffenhet ved mottak	Mottatt Unilab	Analyseperiode
636/36	284 Vuoddasjavri, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/37	286 Oksevatn,0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/38	291 Ratfjord., 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/39	298 Følvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/40	301 Andrevatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/41	302 Langvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/42	303 Lille Ropelvatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/43	312 Langvatn, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/44	316 Caalnbj 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/45	321 Glimmervatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/46	VAINES, 1-2 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/47	Elsejordvatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/48	Valneso, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07
636/49	Hestevatn, Finnmark, 0-1 cm	sediment	Frosent sediment	17.11.2006	27.11.06 – 06.02.07

Analysene gjelder bare for de prøver som er testet. De oppgitte analyseresultat omfatter ikke feil som måtte følge av prøvetagningen, inhomogenitet eller andre forhold som kan ha påvirket prøven før den ble mottatt av laboratoriet. Rapporten får kun kopieres i sin helhet og uten noen form for endringer. En eventuell klage skal leveres laboratoriet senest en måned etter mottak av analyseresultat.

Prøvene ble analysert med følgende resultater (metodeprinsipp og analyseusikkerhet er gitt i egne dokument).

Glødetap (%)

Metode i.d.: NS 4764

Prøve id. Unilab	636/1	636/2	636/3	636/4	636/5	636/6	636/7
Glødetap %	23,6	7,3	6,9	28,9	11,6	13,6	15,3

Prøve id. Unilab	636/8	636/9	636/10	636/11	636/12	636/13	636/14
Glødetap %	29,6	30,1	20,3	12,5	5,9	26,9	29,5

Prøve id. Unilab	636/15	636/16	636/17	636/18	636/19	636/20	636/21
Glødetap %	12,8	7,0	17,0	20,6	6,7	7,3	6,0

Prøve id. Unilab	636/22	636/23	636/24	636/25	636/26	636/27	636/28
Glødetap %	16,2	11,3	16,9	24,1	14,3	41,1	27,3

Prøve id. Unilab	636/29	636/30	636/31	636/32	636/33	636/34	636/35
Glødetap %	24,1	11,3	10,6	23,6	25,8	24,6	17,4

Prøve id. Unilab	636/36	636/37	636/38	636/39	636/40	636/41	636/42
Glødetap %	16,4	13,3	29,7	27,2	5,7	29,9	22,9

Prøve id. Unilab	636/43	636/44	636/45	636/46	636/47	636/48	636/49
Glødetap %	26,8	28,5	12,9	17,6	14,1	23,4	18,1

ANMERKNINGER: Analysene er ikke akkreditert

Innhold av polysykliske aromatiske forbindelser (µg/kg tørrvekt)

Metode i.d.: UA-PAH-s-lut/msd

Prøve id. Unilab	636/1	636/2	636/3	636/4	636/5	636/6	636/7
Naftalen	36,8	23,4	20,9	107	45,7	63,2	30,5
Fenantren	29,5	11,4	8,63	87,8	18,3	45,3	55,1
Antracen	1,74	0,95	0,62	12,2	0,74	4,18	4,86
Acenaftylen	2,05	1,19	0,97	8,49	1,65	3,70	2,76
Acenaften	1,45	0,85	0,92	6,29	0,46	0,98	1,29
Fluoren	4,00	1,54	1,10	10,8	1,79	3,81	5,51
Fluoranten	29,2	19,7	15,6	172	20,6	66,3	71,1
Pyren	15,7	11,9	8,49	90,0	11,6	32,8	34,9
Benzo[a]antracen	8,84	7,13	5,01	61,8	5,63	23,7	26,6
Krysen	56,7	58,9	50,7	381	33,0	162	105
Benzo[b]fluoranten	185	224	188	1667	147	660	517
Benzo[k]fluoranten	*	*	*	*	*	*	*
Benzo[e]pyren	50,2	73,5	61,7	577	32,8	174	140
Benzo[a]pyren	28,2	13,5	10,2	102	9,75	39,0	40,0
Indeno[1,2,3-cd]pyren	63,5	101	86,6	832	40,2	257	295
Benzo[ghi]perylen	67,2	95,5	75,3	748	27,5	187	206
Dibenzo[a,h]antracen	12,4	15,4	12,4	135	7,45	36,1	48,2
SUM 16 EPA**	542	587	485	4421	371	1585	1445

Prøve id. Unilab	636/8	636/9	636/10	636/11	636/12	636/13	636/14
Naftalen	39,8	55,1	72,4	31,4	67,3	57,6	24,1
Fenantren	93,6	53,3	22,6	10,7	33,2	22,7	38,4
Antracen	15,2	5,14	1,11	< 0,041	2,72	2,19	4,99
Acenaftylen	8,92	4,81	1,70	1,10	3,41	1,90	3,37
Acenaften	3,17	4,00	1,05	2,46	2,35	3,47	2,94
Fluoren	8,95	7,23	3,16	3,96	6,74	4,01	4,62
Fluoranten	237	65,2	23,7	3,51	43,5	21,9	69,4
Pyren	119	33,0	12,7	1,50	26,4	11,6	37,1
Benzo[a]antracen	100	25,5	8,00	0,03	16,2	8,26	22,4
Krysen	437	156	49,1	5,71	49,3	43,3	96,2
Benzo[b]fluoranten	2245	539	213	15,1	189	148	400
Benzo[k]fluoranten	*	*	*	*	*	*	*
Benzo[e]pyren	857	156	52,6	2,77	53,8	44,6	156
Benzo[a]pyren	205	37,1	11,4	< 0,09	21,3	10,6	41,4
Indeno[1,2,3-cd]pyren	1411	332	86,8	4,85	133	58,7	232
Benzo[ghi]perylen	1415	228	76,5	5,17	90,7	53,1	227
Dibenzo[a,h]antracen	276	41,5	13,7	1,42	18,6	7,31	36,5
SUM 16 EPA**	6615	1587	597	86,9	704	454	1241

Prøve id. Unilab	636/15	636/16	636/17	636/18	636/19	636/20	636/21
Naftalen	10,4	19,8	27,8	52,5	8,94	9,58	9,93
Fenantren	11,9	9,99	35,2	31,8	2,97	3,90	8,10
Antracen	1,18	0,98	4,07	2,79	0,11	0,51	0,38
Acenaftylen	0,65	0,84	2,34	1,90	0,17	0,20	0,46
Acenaften	0,84	0,85	1,83	1,02	0,18	0,81	0,75
Fluoren	1,61	2,01	3,79	3,60	0,37	1,26	1,81
Fluoranten	15,8	10,1	48,5	35,2	2,36	0,49	4,71
Pyren	4,60	5,14	21,0	16,6	2,00	0,33	2,12
Benzo[a]antracen	4,08	3,35	16,5	11,2	0,12	0,22	1,31
Krysen	18,5	13,0	65,1	80,6	1,99	< 0,068	5,57
Benzo[b]fluoranten	60,4	42,3	268	217	5,98	< 0,063	5,35
Benzo[k]fluoranten	*	*	*	*	*	*	3,20
Benzo[e]pyren	14,8	10,5	78,6	63,0	1,63	0,03	2,21
Benzo[a]pyren	5,18	5,51	23,8	14,8	1,54	0,11	1,93
Indeno[1,2,3-cd]pyren	35,3	23,3	170	84,6	2,12	0,06	4,42
Benzo[ghi]perylen	12,1	14,1	149	69,6	2,11	0,05	3,77
Dibenzo[a,h]antracen	4,72	3,03	21,6	10,6	0,52	< 0,002	0,61
SUM 16 EPA**	187	154	858	634	31,5	17,6	54,4

Prøve id. Unilab	636/22	636/23	636/24	636/25	636/26	636/27	636/28
Naftalen	50,1	11,1	19,6	22,5	23,1	29,5	39,2
Fenantren	32,2	11,5	20,8	22,5	22,6	74,1	50,1
Antracen	2,09	1,27	1,36	1,21	2,73	5,41	3,27
Acenaftylen	2,09	0,54	1,22	1,39	1,05	3,29	2,78
Acenaften	2,34	0,43	2,04	2,97	1,22	4,11	1,99
Fluoren	6,33	1,39	3,16	4,36	2,86	8,84	5,14
Fluoranten	24,5	16,0	16,5	13,1	29,9	78,0	45,5
Pyren	9,87	7,62	9,62	5,86	14,4	34,8	17,5
Benzo[a]antracen	7,47	4,43	5,17	4,72	12,5	24,7	18,1
Krysen	52,6	18,8	26,0	30,8	64,8	149	143
Benzo[b]fluoranten	109	32,2	51,7	27,8	134	272	200
Benzo[k]fluoranten	*	16,5	*	11,9	*	107	*
Benzo[e]pyren	27,5	11,9	14,0	10,5	35,4	114	51,0
Benzo[a]pyren	8,25	6,81	6,43	3,94	14,1	49,1	14,8
Indeno[1,2,3-cd]pyren	59,7	36,1	21,7	18,3	83,0	247	92,0
Benzo[ghi]perylen	40,2	22,7	18,1	16,9	60,6	229	74,8
Dibenzo[a,h]antracen	6,11	3,41	3,38	2,71	11,8	38,05	18,6
SUM 16 EPA**	413	191	207	191	479	1354	726

Prøve id. Unilab	636/29	636/30	636/31 ikke akk.	636/32	636/33	636/34	636/35
Naftalen	68,7	26,9	7,48	21,7	61,9	45,7	38,3
Fenantren	29,9	12,0	6,90	20,9	43,9	30,0	12,8
Antracen	1,94	1,12	0,63	1,92	15,6	2,60	1,15
Acenaftylen	1,77	1,33	0,6	1,52	1,46	1,10	1,53
Acenaften	3,33	3,41	0,10	2,70	4,49	3,48	2,54
Fluoren	7,11	4,01	1,13	3,86	3,76	3,56	2,92
Fluoranten	26,2	7,12	11,4	22,1	13,4	28,1	9,79
Pyren	11,5	4,22	3,45	16,5	18,4	25,1	5,92
Benzo[a]antracen	7,69	3,91	2,79	6,47	4,53	18,9	3,47
Krysen	60,6	12,9	17,0	17,0	12,0	64,0	13,23
Benzo[b]fluoranten	97,8	15,2	65,7	80,8	34,7	90,5	67,9
Benzo[k]fluoranten	*	9,27	*	*	11,9	50,1	*
Benzo[e]pyren	23,6	7,80	18,9	31,4	17,9	281	16,8
Benzo[a]pyren	10,9	4,88	2,20	21,0	11,5	924	5,28
Indeno[1,2,3-cd]pyren	35,6	15,7	20,8	55,8	-	45,8	31,1
Benzo[ghi]perylen	2,65	15,0	16,9	57,0	-	135	21,4
Dibenzo[a,h]antracen	8,24	2,97	6,38	5,61	-	-	3,20
SUM 16 EPA**	374	140	163	335	238	1468	221

-forbindelsen er maskert

Prøve id. Unilab	636/36	636/37	636/38	636/39	636/40	636/41	636/42
Naftalen	18,5	58,6	51,7	30,8	21,3	95,5	84,9
Fenantren	12,6	17,7	28,5	26,9	12,6	47,6	43,1
Antracen	1,05	0,73	1,51	1,97	1,72	3,79	3,62
Acenaftylen	1,17	1,25	2,67	1,94	0,67	2,72	3,68
Acenaften	1,96	2,38	3,53	1,59	0,58	3,77	4,95
Fluoren	2,99	3,46	6,42	3,95	2,21	5,95	6,44
Fluoranten	14,4	14,1	23,1	25,9	22,3	53,0	48,1
Pyren	6,70	4,24	8,88	9,69	15,2	29,7	26,0
Benzo[a]antracen	3,05	2,91	5,66	5,75	8,86	58,5	14,8
Krysen	9,73	25,17	49,5	38,0	16,2	15,3	48,3
Benzo[b]fluoranten	33,4	40,4	92,5	89,7	36,9	172	152
Benzo[k]fluoranten	*	*	*	*	*	*	*
Benzo[e]pyren	11,0	7,92	24,5	24,2	12,8	58,2	44,8
Benzo[a]pyren	5,92	3,68	8,11	6,60	10,7	22,4	18,3
Indeno[1,2,3-cd]pyren	18,5	16,0	43,1	40,5	10,5	77,9	64,0
Benzo[ghi]perylen	5,55	10,5	28,1	30,0	11,4	79,8	58,3
Dibenzo[a,h]antracen	1,36	1,83	4,96	6,87	2,13	9,55	7,41
SUM 16 EPA**	137	203	358	320	173	677	584

Prøve id. Unilab	636/43	636/44	636/45	636/46	636/47	636/48	636/49
Naftalen	55,2	80,6	41,6	32,4	33,4	54,8	42,4
Fenantren	45,4	51,5	29,4	24,5	31,0	57,6	28,0
Antracen	3,75	4,06	22,4	3,89	3,58	9,39	3,44
Acenaftylen	3,01	3,04	2,82	2,72	3,18	6,42	2,37
Acenaften	3,81	1,73	1,97	0,50	1,48	1,87	1,92
Fluoren	5,42	5,85	3,08	2,66	4,15	6,42	3,67
Fluoranten	55,3	71,8	30,4	36,3	45,8	83,4	32,5
Pyren	29,8	26,9	19,8	24,4	24,2	58,2	15,6
Benzo[a]antracen	14,4	18,3	11,4	22,2	16,8	48,9	13,3
Krysen	65,7	105	34,3	61,3	70,5	126	79,1
Benzo[b]fluoranten	181	286	82,6	244	203	382	211
Benzo[k]fluoranten	*	*	*	*	*	139	*
Benzo[e]pyren	49,5	81,6	24,2	70,2	64,3	157	66,2
Benzo[a]pyren	17,6	22,3	12,2	27,5	25,2	64,4	17,4
Indeno[1,2,3-cd]pyren	76,9	133	32,0	265	150	556	110
Benzo[ghi]perylen	57,2	111	32,9	221	128	453	123
Dibenzo[a,h]antracen	9,41	15,3	5,30	46,8	21,1	101	16,2
SUM 16 EPA**	624	936	362	1015	760	2148	701

ANMERKNINGER: Analysene er akkreditert, med unntak av UA 636/31.
*Forbindelsen co-eluerer med Benzo[b]fluoranten
**Ved beregning av sum er ½ LOQ benyttet for konsentrasjoner mindre enn LOQ.

Unilab ANALYSE A.S
Polarmiljøsenteret, 9296 TROMSØ
Foretaksnr.: NO 950 614 110 MVA
Tel: 77 75 03 50
Fax: 77 75 03 01

ANALYSE RAPPORT

NORSK AKKREDITERING TEST 061

Kunde: Akvaplan-niva as
Kunde referanse: AMAP
Kontaktperson: Guttorm Christensen
Adresse: Polarmiljøsenteret
Postnr./sted: 9296 Tromsø
Tel: 77 75 03 30
Fax: 77 75 03 01

Dato: 26.02.2007

Rapport nr.: UA649.PAH-s, TOM-s
Analyseparameter(e): PAH-16EPA, glødetap
Kontaktperson: Linda Hanssen

Analyseansvarlig: Linda Hanssen (sign.)

Underskriftsberettiget: Hanne Foshaug (sign.)

Prøvene ble levert ved Unilab Analyse AS av oppdragsgiver, og merket som angitt i tabellen nedenfor.

Prøve id. Unilab	Kundens id.	Matrix	Prøvens beskaffenhet ved mottak	Mottatt Unilab	Analyseperiode
649/1	Holmvatn, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/2	Holmvatn, 1-2 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/3	Storvikv. , 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/4	Langv. Kvaløya, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/5	226, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/6	227, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/7	Langvatn, 257, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/8	Langvatn, 258, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07
649/9	Bakketækjavn, 261, 0-1 cm	sediment	Frosent sediment	08.02.07	12.02.07 – 19.02.07

Prøvene ble analysert med følgende resultater (metodeprinsipp og analyseusikkerhet er gitt i egne dokument).

Glødetap (%)

Metode i.d.: NS-4764

Prøve id. Unilab	649/1	649/2	649/3	649/4	649/5	649/6	649/7
Glødetap %	19,1	19,2	19,8	40,8	19,5	23,7	19,5

Metode i.d.: UA-

Prøve id. Unilab	649/8	649/9
Glødetap %	24,3	29,0

ANMERKNINGER: Analysene er ikke akkreditert

Innhold av polysykliske aromatiske forbindelser (µg/kg tørrvekt)

Metode i.d.: UA-PAH-s-lut/msd

Prøve id. Unilab	649/1	649/2	649/3	649/4	649/5	649/6
Naftalen	23,2	38,9	24,6	14,3	42,6	22,8
Fenantren	22,2	35,3	51,1	67,2	105	66,9
Antracen	2,04	2,79	4,29	3,74	12,1	10,6
Acenaftylen	1,11	1,97	2,07	2,28	7,08	6,27
Acenaften	0,58	0,96	2,39	11,9	3,36	4,15
Fluoren	2,03	4,94	7,40	11,0	9,81	6,64
Fluoranten	29,2	49,2	59,0	104	187	208
Pyren	21,0	24,0	28,4	58,8	98,9	97,6
Benzo[a]antracen	11,0	19,9	21,7	20,2	66,3	51,5
Krysen	35,8	38,9	92,7	71,2	344	222
Benzo[b]fluoranten	121	122	264	182	1506	859
Benzo[k]fluoranten	*	65,3	*	*	*	*
Benzo[e]pyren	55,9	83,7	108	64,5	555	353
Benzo[a]pyren	18,6	12,7	85,6	194	180	83,2
Indeno[1,2,3-cd]pyren	116	192	204	121	1048	559
Benzo[ghi]perylen	89,7	154	191	118	875	493
Dibenzo[a,h]antracen	30,3	41,4	34,6	22,2	156	90,4
SUM 16 EPA**	523	805	1072	1002	4641	2781

Prøve id. Unilab	649/7	649/8	649/9
Naftalen	9,38	41,8	29,5
Fenantren	13,8	50,2	32,6
Antracen	0,95	2,93	1,78
Acenaftylen	0,68	1,75	1,47
Acenaften	0,80	3,33	4,04
Fluoren	2,01	7,44	7,27
Fluoranten	18,0	56,7	26,6
Pyren	5,88	13,9	11,4
Benzo[a]antracen	4,85	15,2	7,26
Krysen	38,7	120	46,9
Benzo[b]fluoranten	70,8	182	97,9
Benzo[k]fluoranten	*	*	*
Benzo[e]pyren	23,4	54,8	31,2
Benzo[a]pyren	8,63	18,1	11,7
Indeno[1,2,3-cd]pyren	45,0	105	45,2
Benzo[ghi]perylen	35,3	64,8	41,2
Dibenzo[a,h]antracen	8,15	20,3	7,82
SUM 16 EPA**	263	703	373

ANMERKNINGER: Analysene er akkreditert.
*Forbindelsen co-eluerer med Benzo[b]fluoranten
**Ved beregning av sum er ½ LOQ benyttet for konsentrasjoner mindre enn LOQ.

Unilab ANALYSE A.S
Polarmiljøsenteret, 9296 TROMSØ
Foretaksnr.: NO 950 614 110 MVA
Tel: 77 75 03 50
Fax: 77 75 03 01

ANALYSE RAPPORT

NORSK AKKREDITERING TEST 061

Kunde: Akvaplan-niva as
Kunde referanse: AMAP
Kontaktperson: Guttorm Christensen
Adresse: Polarmiljøsenteret
Postnr./sted: 9296 Tromsø
Tel: 77 75 03 30
Fax: 77 75 03 01

Dato: 21.02.2008

Rapport nr.: UA641.PAH-s.Del A
Merk: Delrapport av UA641.PAH-s datert 26.02.2007
Analyseparameter(e): PAH-16EPA
Kontaktperson: Lisa Torske

Analyseansvarlig: Linda Hanssen (sign.)

Underskriftsberettiget: Hanne Foshaug (sign.)

Prøvene ble levert ved Unilab Analyse AS av oppdragsgiver, og merket som angitt i tabellen nedenfor.

Prøve id. Unilab	Kundens id.	Matrix	Prøvens beskaffenhet ved mottak	Mottatt Unilab	Analyseperiode
641/1	3	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/2	5	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/3	7	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/4	10	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/5	16	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/6	17	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/7	27	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/8	37	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/9	38	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/10	45	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/11	46	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/12	54	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/13	58	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/14	64	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/15	66	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/16	70	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07

Prøve id. Unilab	Kundens id.	Matrix	Prøvens beskaffenhet ved mottak	Mottatt Unilab	Analyseperiode
641/17	73	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/18	78	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/19	95	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/20	100	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/21	107	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/22	122	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/23	124	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/24	126	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/25	128	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/26	138	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/27	142	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/28	148	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/29	149	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/30	151	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/31	157	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/32	158	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/33	159	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/34	160	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/35	164	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/36	165	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/37	166	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/38	168	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/39	169	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/40	171	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/41	179	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/42	180	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/43	181	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/44	183	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/45	185	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/46	187	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/47	188	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/48	191	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07
641/49	192	sediment	Tørket sediment	30.11.2006	06.12.06 – 30.01.07

Prøvene ble analysert med følgende resultater (metodeprinsipp og analyseusikkerhet er gitt i egne dokument).

Innhold av polysykliske aromatiske forbindelser (µg/kg tørrvekt)

Metode i.d.: UA-PAH-s-lut/msd

Prøve id. Unilab	641/1	641/2	641/3	641/4	641/5	641/6	641/7
Naftalen	104	326	106	99,1	114	96,9	92,9
Fenantren	54,6	66,8	195	36,2	227	278	304
Antracen	146	300	17,1	158	19,3	34,9	27,7
Acenaftylen	4,80	13,2	7,04	6,04	10,2	17,3	10,5
Acenaften	31,6	74,4	18,5	29,2	19,9	12,6	10,4
Fluoren	37,3	49,6	22,9	26,1	26,0	30,4	25,3
Fluoranten	152	560	365	127	399	761	799
Pyren	89,7	342	223	161	276	454	357
Benzo[a]antracen	39,4	165	147	54,2	144	280	191
Krysen	293	1043	587	345	541	1062	914
Benzo[b]fluoranten	926	3434	1212	1431	1408	2739	2150
Benzo[k]fluoranten	*	*	497	*	571	881	*
Benzo[e]pyren	289	1004	559	398	626	1098	692
Benzo[a]pyren	54,2	267	253	87,5	190	472	186
Indeno[1,2,3-cd]pyren	275	1308	764	462	884	2116	1808
Benzo[ghi]perylen	233	1143	744	326	773	620	2466
Dibenzo[a,h]antracen	63,5	404	242	90,7	170	464	393
SUM 16 EPA**	2503	9497	5401	3440	5770	10319	9735

Prøve id. Unilab	641/8	641/9	641/10	641/11	641/12	641/13	641/14
Naftalen	38,8	149	235	105	90,1	146	261
Fenantren	51,6	274	377	216	302	333	349
Antracen	4,43	15,5	33,0	24,5	36,9	27,2	25,5
Acenaftylen	2,59	6,58	15,4	8,37	12,8	6,12	10,9
Acenaften	5,00	7,37	52,3	6,29	16,7	4,59	57,5
Fluoren	5,35	23,4	43,5	5,82	20,2	7,34	66,4
Fluoranten	85,0	331	469	348	1398	396	355
Pyren	41,4	110	337	170	709	195	190
Benzo[a]antracen	23,0	59,9	207	115	354	138	116
Krysen	91,6	451	941	719	1661	760	768
Benzo[b]fluoranten	287	1554	3042	2431	4314	4671	2710
Benzo[k]fluoranten	*	*	830	*	*	*	*
Benzo[e]pyren	101	368	1348	483	1204	1210	585
Benzo[a]pyren	46,3	77,6	325	141	584	165	164
Indeno[1,2,3-cd]pyren	198	501	2199	733	1818	2117	857
Benzo[ghi]perylen	184	324	1360	602	1792	1363	646
Dibenzo[a,h]antracen	28,0	102	428	109	359	281	145
SUM 16 EPA**	1093	3987	10895	5734	13468	10610	6721

Prøve id. Unilab	641/15	641/16	641/17	641/18	641/19	641/20	641/21
Naftalen	86,2	135	62,8	73,7	129	186	74,8
Fenantren	319	271	176	157	665	319	212
Antracen	28,7	20,7	14,5	11,2	66,1	30,0	17,2
Acenaftylen	11,2	9,6	4,65	4,19	20,7	11,0	7,16
Acenaften	17,3	20,2	10,6	7,39	18,5	32,5	17,8
Fluoren	8,89	37,3	15,6	21,9	50,7	53,8	10,1
Fluoranten	435	369	152	206	1701	705	439
Pyren	279	174	84,9	76,9	904	435	252
Benzo[a]antracen	162	149	52,7	53,8	635	309	128
Krysen	960	779	322	255	2895	1225	991
Benzo[b]fluoranten	3925	2390	1133	801	8388	2214	2852
Benzo[k]fluoranten	*	*	*	*	*	809	*
Benzo[e]pyren	861	672	283	230	2681	972	817
Benzo[a]pyren	193	155	82,1	76,5	670	406	116
Indeno[1,2,3-cd]pyren	799	944	367	416	4696	1240	1123
Benzo[ghi]perylen	490	752	263	305	4997	1081	927
Dibenzo[a,h]antracen	181	146	55,6	53,2	1276	256	288
SUM 16 EPA**	7894	6353	2795	2519	27112	9314	7455

Prøve id. Unilab	641/22	641/23	641/24	641/25	641/26	641/27	641/28
Naftalen	244	285	302	205	189	73,6	175
Fenantren	382	658	734	341	558	250	291
Antracen	34,8	70,3	72,9	27,6	63,0	16,2	30,6
Acenaftylen	11,1	31,2	22,1	8,88	23,9	7,64	10,9
Acenaften	76,6	57,6	16,7	60,3	39,1	12,7	26,5
Fluoren	110	100	27,0	53,7	67,2	22,2	32,9
Fluoranten	488	1101	1638	456	845	292	533
Pyren	321	889	949	305	576	196	386
Benzo[a]antracen	202	567	554	170	404	136	300
Krysen	1126	2126	2827	859	1901	775	1310
Benzo[b]fluoranten	4536	11969	10631	1555	7231	3228	4124
Benzo[k]fluoranten	*	*	*	413	*	*	865
Benzo[e]pyren	1527	3488	3342	649	2398	823	1532
Benzo[a]pyren	244	775	479	186	560	179	440
Indeno[1,2,3-cd]pyren	1917	4246	5955	596	3355	911	1772
Benzo[ghi]perylen	1516	3106	4936	530	2642	660	1637
Dibenzo[a,h]antracen	445	864	1578	131	603	181	390
SUM 16 EPA**	11653	26844	30720	5897	19058	6940	12324

Prøve id. Unilab	641/29	641/30	641/31	641/32	641/33	641/34	641/35
Naftalen	94,7	120	507	145	167	155	234
Fenantren	179	311	1525	291	314	604	1007
Antracen	9,95	21,4	197	32,4	31,0	75,4	122
Acenaftylen	4,24	5,65	66,4	11,7	8,44	32,6	45,9
Acenaften	12,7	27,7	50,5	13,5	59,5	15,1	16,5
Fluoren	21,3	26,5	69,2	21,6	66,5	38,3	57,7
Fluoranten	258	286	4159	569	360	1546	2215
Pyren	92	148	2657	288	248	988	1602
Benzo[a]antracen	60	109	1977	235	141	709	1158
Krysen	482	548	7875	1159	784	2175	4483
Benzo[b]fluoranten	1474	1257	28834	3785	3565	10446	15671
Benzo[k]fluoranten	*	344	544	*	*	2056	*
Benzo[e]pyren	362	506	8050	1290	1256	4083	6237
Benzo[a]pyren	82,5	142	1833	205	199	783	1048
Indeno[1,2,3-cd]pyren	435	855	14639	2230	1237	7880	11019
Benzo[ghi]perylen	307	675	11478	1806	1050	6277	9434
Dibenzo[a,h]antracen	79,4	112	4108	494	227	2295	2510
SUM 16 EPA**	3592	4989	80518	11287	8458	36077	50624

Prøve id. Unilab	641/36	641/37	641/38	641/39	641/40	641/41	641/42
Naftalen	202	217	271	27,6	265	78,0	56,5
Fenantren	361	305	299	279	170	137	42,7
Antracen	30,1	30,6	32,0	26,6	13,2	10,7	1,50
Acenaftylen	11,9	12,9	6,45	1,47	4,86	3,64	1,11
Acenaften	43,9	45,9	83,2	6,70	23,5	23,5	6,11
Fluoren	61,1	30,6	30,6	8,71	19,1	15,4	5,67
Fluoranten	500	451	603	86,8	177	190	72,5
Pyren	404	332	390	43,8	82,6	103	18,6
Benzo[a]antracen	269	220	226	28,6	52,9	65,8	9,11
Krysen	1354	954	1286	165	292	244	59,2
Benzo[b]fluoranten	4541	5306	4288	522	1085	858	121
Benzo[k]fluoranten	1440	*	*	*	*	*	*
Benzo[e]pyren	2002	1976	1729	143	419	354	47,1
Benzo[a]pyren	423	326	218	37,0	54,1	101	10,1
Indeno[1,2,3-cd]pyren	2441	2321	2525	174	478	339	40,1
Benzo[ghi]perylen	2083	2060	2551	122	419	364	35,5
Dibenzo[a,h]antracen	367	424	614	26,6	94,7	52,8	10,9
SUM 16 EPA**	14533	13037	13424	1556	3229	2585	491

Prøve id. Unilab	641/43	641/44	641/45	641/46	641/47	641/48	641/49
Naftalen	53,7	83,5	53,5	88,0	38,0	35,8	13,1
Fenantren	48,1	53,5	55,6	127	47,8	27,0	19,3
Antracen	1,98	3,21	3,14	8,93	2,02	3,14	1,10
Acenaftylen	2,83	7,15	1,45	4,44	1,35	1,66	0,27
Acenaften	6,81	11,3	11,6	10,5	5,71	4,07	2,67
Fluoren	4,18	4,76	9,98	11,9	3,48	4,90	1,98
Fluoranten	77,8	54,0	132	191	36,8	30,6	27,0
Pyren	31,5	144	64,2	141	41,8	119	27,0
Benzo[a]antracen	17,2	15,2	20,9	45,8	13,1	7,76	8,21
Krysen	116	52,0	105	362	49,3	34,7	25,1
Benzo[b]fluoranten	294	78,8	304	837	207	116	111
Benzo[k]fluoranten	*	*	*	*	*	*	*
Benzo[e]pyren	107	29,9	93,7	413	70,1	39,7	42,2
Benzo[a]pyren	21,8	34,3	24,3	58,8	13,1	14,2	15,2
Indeno[1,2,3-cd]pyren	126	14,7	60,0	439	89,1	26,6	57,1
Benzo[ghi]perylen	40,7	98,9	49,7	498	70,2	13,9	59,1
Dibenzo[a,h]antracen	28,8	4,29	11,7	80,0	11,5	2,67	7,59
SUM 16 EPA**	871	660	906	2904	630	442	375

ANMERKNINGER: Analysene er akkreditert.
*Forbindelsen co-eluerer med Benzo[b]fluoranten
**Ved beregning av sum er ½ LOQ benyttet for konsentrasjoner mindre enn LOQ.

8.4 Appendix 4: Environmental pollutans in fish and sediments

SCIENTIFIC PRODUCTION ASSOCIATION "TYPHOON"
Center for Environmental Chemistry

REPORT ON THE SUB-PROJECT

"Analytical Determination of PTS levels in bottom sediments and biota"

PROJECT TITLE:

"Contaminant Levels in biota and sediment samples in frame of the Contract 2/07"

Performed under CONTRACT between Centre for Environmental Chemistry of Scientific Production Association "Typhoon" and Akvaplan-niva

Project Manager: Alexei Konoplev

Contributors: L.Alexeeva, A.Kochetkov, D.Samsonov, E.Pasynkova, T.Rakhmanova, G.Moshkarova, G.Khomushku, A.Pantukhina, T.Morshina

Obninsk,
September, 2007

Appendix 4. *Continues.*

Table of content of analytical report from "Typhoon"

Introduction

According to the contract with Akvaplan-niva the Centre for Environmental Chemistry of SPA "Typhoon" has been analyzing 59 samples of bottom sediments and 18 samples of fish tissues. The work was carried out in frame of the project "Contaminant Levels in biota and sediment samples.".

The following persistent pollutants have been determined in the samples:

- chlorinated pesticides: DDT-group, HCH, HCB, chlordanes, nonachlors, heptachlor, mirex and dieldrin;
- planar and non-orthosubstituted congeners of PCBs (IUPAC): # 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189, as well as PCB congeners # 170 and 180;
- congeners of polychlorinated byphenyls;
- brominated flame-retardants 2,4,4`–TrBDE (#28); 2,2`,4,4`-TeBDE (#47); 2,2`,4,4`,5-PBDE (#99); 2,2`,4,4`,6-PBDE (#100); 2,2',4,4',5,5'- HeBDE (#153); 2,2',4,4',5,6-HeBDE (#154); 2,2',3,4,4',5,6-HpBDE (#183);
- polychlorinated dibenzo-p-dioxines and dibenzofurans;
- polycyclic aromatic hydrocarbons (PAH);
- heavy metals.

Samples have been analyzed in the analytical batches, which included laboratory procedural blanks, spiked matrix samples and samples of standard reference material. To control recovery of analytes surrogate isotope-labelled substances have been used, which were introduced into samples before extraction. Extracts have been analyzed using GC/MS for POPs and AAS for metals.

1 Sample preparation for analysis

Before analysis samples were defrozen and homogenized. The samples of bottom sediments were dried.

1.1 Extraction of POPs from fish tissues samples

Schemes of clean-up for all types of extracts are presented on Fig.1, 2, 3 and 4.

1.1.1 Extraction of PCBs, PBDEs, PCDD/Fs and OCPs

POPs from fish tissue samples were extracted by column extraction method. As extragent the mixture of solvents – hexane : dichlormethane = 1:1 (v/v) was used. Lipid content was

3

determined by gravimetric method from 10% of extract volume. The 50 % of extract volume was used for clean up for PCDD/Fs and PBDEs analysis. The 40 % of extract volume was used for clean up for another POPs analysis.

1.1.2 Extraction of PAH

Extraction of PAH from the samples of the fish tissues was carried out using base digestion with methanol and 50% KOH solution. The analytes from base solution were extracted with two portions of hexane in separatory funnel.

1.2 Extraction of POPs from bottom sediments samples

1.2.1 Extraction of PCBs, PBDEs, PCDD/Fs and OCPs

Extraction of bottom sediments was carried out in Soxhlet apparatus using solvent mixture benzene-ethanol during 16 hours. Determinations of PCBs, chlorinated pesticides, PCDD/PCDFs, PBDEs and planar congeners of PCBs were carried out from the same extract.

1.2.2 Extraction of PAH

Ultrasonic extraction procedures were used to determine PAHs.

4

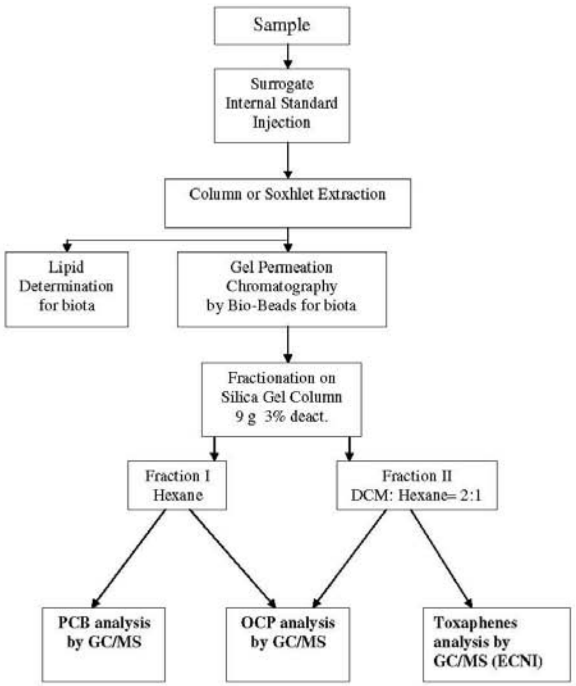


Fig.1 Analysis scheme for PCBs, OCPs and toxaphenes

5

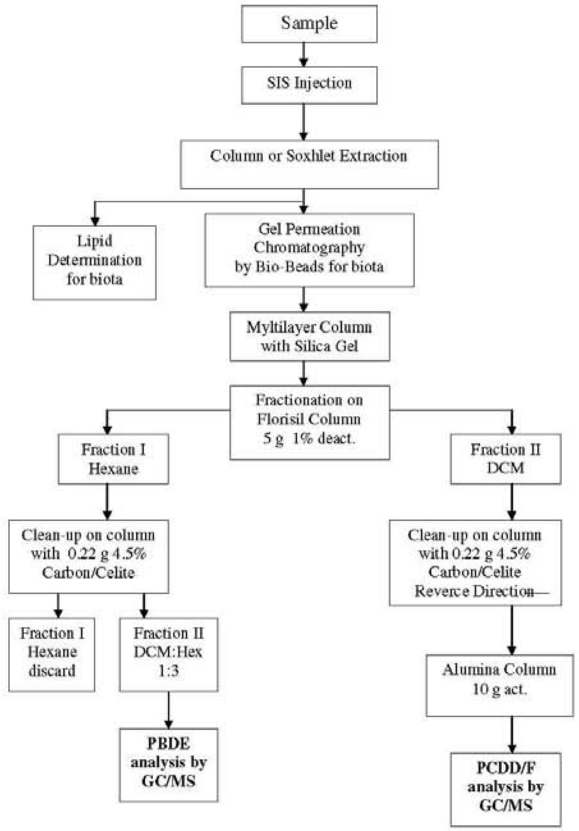


Fig.2 Analysis scheme for PCDD/PCDF and PBDE

6

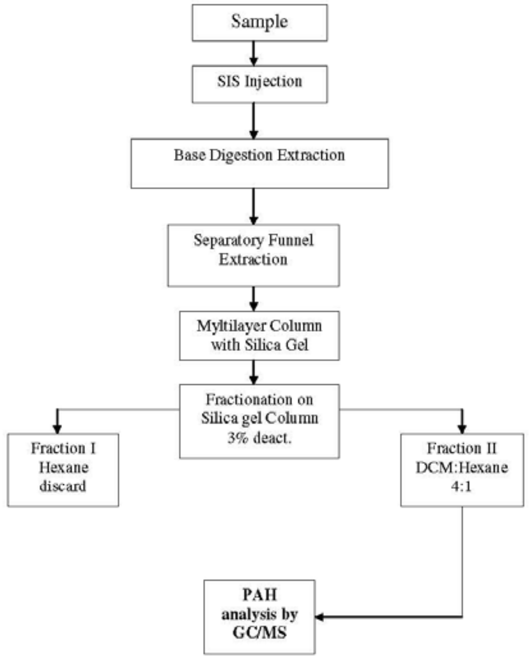


Fig.3 Analysis for PAH scheme

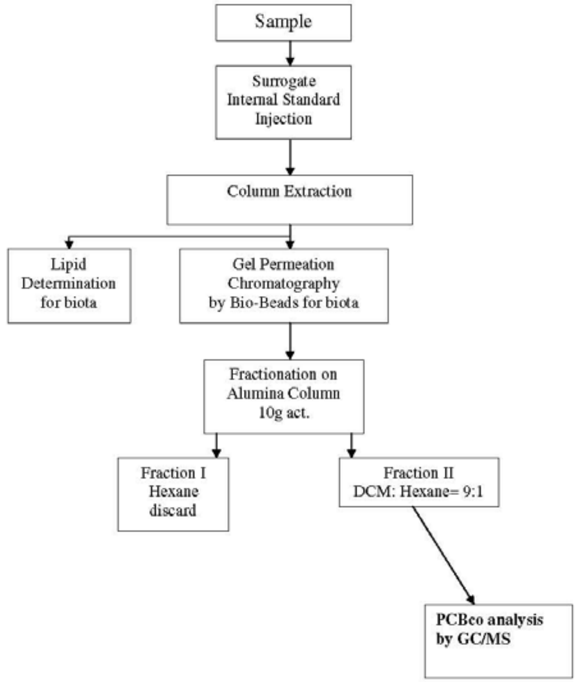


Fig.4 Analysis scheme for planar and mono-orthosubstituted congeners of PCB

7

8

2. Instrumental analysis (HRGC/LRMS)

2.1 Polychlorinated biphenyls and OCPs

The analysis was performed with GC/MS Varian Saturn 2200 T. Calibration of the instrument was carried out using a standard mixture of biphenyls BP-MS, Wellington Laboratories and SRM-1492, NIST. Results of analyses were processed with software package Varian 5.2.

2.2 Polychlorinated dibenzo-p-dioxins/dibenzofurans and Polybrominated diphenyl ethers

The analysis was performed with GC/MS Varian Saturn 1200 using chemical ionization with detection of negative ions (NCI) in the selective ion monitoring (SIM) mode. The reagent gas was methane.

Calibration of the instrument was carried out with standard solutions of PCDD/PCDF prepared on the base of the mixture EDF 7999 Cambridge Isotope Lab. and standard solutions of PBDE prepared on the base of the mixture EO-4980, Cambridge Isotope Lab.

3. Analysis of heavy metals

3.1 Analysis of heavy metals in bottom sediments samples

The extraction of Cd, Co, Cr, Cu, Ni, Pb, Zn from bottom sediments samples were carried out by full decomposition of the sample with HF (hydrofluoric), HNO_3 (nitric) and HCl (hydrochloric) acids mixture.

Cd was measured by a furnace technique on Perkin Elmer Z-3030 with Zeeman correction of background.

Zn, Ni, Cu, Pb, Cr, Co were measured by AAS method by flame procedure on Perkin Elmer B-3030.

Hg was measured by method of "cold vapor" on MHS 15 after a decomposition of a sample by mixture of sulfuric and nitric acids.

As was measured by borhydrid method on MHS 15 after a decomposition of the sample by mixture of sulfuric and perchloric acids.

Extraction of Se was carried out with mixture of H_2SO_4 (sulphuric) and HClO4 (chlorine) acids, then conversion of Se to 5-nitro-2,1,3-benzoselendiasol and extaction with chloroform. Se was measured by unflame technique on Perkin Elmer Z-3030 with Zeeman correction of background.

3.2 Analysis of heavy metal in fish samples

Cd, Co, Cr, Cu, Ni, Pb were measured by furnace technique on Perkin Elmer Z-3030 with Zeeman correction of background after ashing at 450 °C and solution in nitric acid.

Zn was measured by AAS method by flame procedure on Perkin Elmer B-3030 after ashing at 450°C and solution in nitric acid.

Hg was measured by standard addition method after decomposition of sample with H_2SO_4 (sulphuric) and HNO_3 (nitric) acids on MHS 15.

As was measured by borhydrid method on MHS 15 after a decomposition of the sample by mixture of sulfuric and perchloric acids.

Extraction of Se was carried out with mixture of H_2SO_4 (sulphuric) and HClO4 (chlorine) acids, then conversion of Se to 5-nitro-2,1,3-benzoselendiasol and extaction with chloroform. Se was measured by unflame technique on Perkin Elmer Z-3030 with Zeeman correction of background.

4. QA/QC results

The internal QA/QC program in samples analysis for organic pollutants involved control for possible contamination of samples during sample preparation and measurements.

The analysis was performed in batches. Each batch included a procedural blank, one duplicate sample, spiked matrix sample with the known content of added analytes or reference material.

Recovery of organic analytes was controlled using isotope-labeled analogues of determined analytes.

QA/QC results are presented in the Tables 4.1 - 4.13.

Quality assurance and quality control for heavy metals included analysis of blanks, analysis of duplicates, use of reference materials and matrix spike recoveries. Results on QA/QC analysis for biota samples are presented in table 4.14-4.15.

Table 4.1.1

QA/QC DATA REPORT for congeners of PCB in sediment

Compound	Method Detection Limit, ng/g	Procedural Blank PBS01, ng/g	Procedural Blank PBS08, ng/g	Procedural Blank PBS09, ng/g	Duplicate Difference, %D	
					PAS 12	PAS 35
#1 [CL1]	0.02	n.d.	n.d.	n.d.	–	–
#3 [CL1]	0.02	n.d.	n.d.	n.d.	–	–
#4/#10 [CL2]	0.02	n.d.	n.d.	n.d.	–	–
#8 [CL2]	0.02	n.d.	n.d.	n.d.	–	–
#19 [CL3]	0.02	n.d.	n.d.	n.d.	–	–
#17/#18 [CL3]	0.02	n.d.	n.d.	n.d.	–	–
#28/#31 [CL3]	0.04	n.d.	0.11	n.d.	17	–
#54 [CL4]	0.05	n.d.	n.d.	n.d.	–	–
#33 [CL3]	0.05	n.d.	n.d.	n.d.	–	–
#22 [CL3]	0.05	n.d.	n.d.	n.d.	–	–
#52 [CL4]	0.02	0.12	n.d.	n.d.	–	–
#49 [CL4]	0.02	n.d.	n.d.	n.d.	–	–
#104 [CL5]	0.02	n.d.	n.d.	n.d.	–	–
#44 [CL4]	0.02	n.d.	n.d.	n.d.	–	–
#37 [CL3]	0.02	n.d.	n.d.	n.d.	–	–
#74 [CL4]	0.02	n.d.	n.d.	n.d.	24	–
#70 [CL4]	0.02	n.d.	n.d.	n.d.	24	–
#95 [CL5]	0.02	n.d.	n.d.	n.d.	25	–
#155 [CL6]	0.02	n.d.	n.d.	n.d.	–	–
#101 [CL5]	0.05	n.d.	n.d.	n.d.	23	–
#99 [CL5]	0.02	n.d.	n.d.	n.d.	18	–
#119 [CL5]	0.02	n.d.	n.d.	n.d.	–	–
#87 [CL5]	0.02	n.d.	n.d.	n.d.	–	–
#110 [CL5]	0.10	n.d.	0.15	n.d.	24	–
#151 [CL6]	0.02	n.d.	n.d.	n.d.	–	–
#149 [CL6]	0.02	n.d.	n.d.	n.d.	24	–
#123 [CL5]	0.02	n.d.	n.d.	n.d.	–	–
#118 [CL5]	0.02	0.14	0.12	0.09	24	14
#114 [CL5]	0.02	n.d.	n.d.	n.d.	–	–
#188 [CL7]	0.02	n.d.	n.d.	n.d.	–	–
#153 [CL6] + #168	0.02	n.d.	0.06	0.11	21	–
#105 [CL5]	0.02	n.d.	0.15	n.d.	25	–
#138 [CL6] + #158	0.05	n.d.	n.d.	n.d.	25	–
#178 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#187 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#183 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#128 [CL6]	0.05	n.d.	n.d.	n.d.	18	–
#167 [CL6]	0.05	n.d.	n.d.	n.d.	–	–
#177 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#202 [CL8]	0.05	n.d.	n.d.	n.d.	–	–
#171 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#156 [CL6]	0.05	n.d.	n.d.	n.d.	–	–
#201 [CL8]	0.05	n.d.	n.d.	n.d.	–	–
#157 [CL5]	0.05	n.d.	n.d.	n.d.	–	–

Cont. table 4.1.1

QA/QC DATA REPORT for congeners of PCB in sediment

Compound	Method Detection Limit, ng/g	Procedural Blank PBS01, ng/g	Procedural Blank PBS08, ng/g	Procedural Blank PBS09, ng/g	Duplicate Difference, %D	
					PAS 12	PAS 35
#180 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#191 [CL7]	0.02	n.d.	n.d.	n.d.	–	–
#170 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#199 [CL8]	0.05	n.d.	n.d.	n.d.	–	–
#189 [CL7]	0.05	n.d.	n.d.	n.d.	–	–
#208 [CL9]	0.05	n.d.	n.d.	n.d.	–	–
#194 [CL8]	0.02	n.d.	n.d.	n.d.	–	–
#205 [CL9]	0.05	n.d.	n.d.	n.d.	–	–
#206 [CL9]	0.05	n.d.	n.d.	n.d.	–	–
#209 [CL10]	0.1	n.d.	n.d.	n.d.	–	–
		Surrogate Internal Standards, % Recovery				
#28 [CL3] C^{13}	0.02	*72*	*91*	*79*	–	–
#52 [CL4] C^{13}	0.02	*75*	*75*	*71*	–	–
#101 [CL5] C^{13}	0.02	*77*	*77*	*70*	–	–
#153 [CL6] C^{13}	0.02	*61*	*81*	*89*	–	–
#138 [CL6] C^{13}	0.02	*59*	*80*	*76*	–	–
#180 [CL7] C^{13}	0.02	*77*	*92*	*100*	–	–
#209 [CL10] C^{13}	0.02	*92*	*82*	*77*	–	–

Table 4.1.2

QA/QC DATA REPORT for congeners of PCB in sediment

Compound	Certified Reference Materials of NWRI EC-5 Reference Value, ng/g	Detected, ng/g	
		SMS 01	SMS 09
#1 [CL1]	–	–	–
#3 [CL1]	–	–	–
#4/#10 [CL2]	–	–	–
#8 [CL2]	–	–	–
#19 [CL3]	–	–	–
#17/#18 [CL3]	3.0 ± 1.1	3.84	2.27
#28/#31 [CL3]	5.3 ± 1.3	4.83	5.77
#54 [CL4]	–	–	–
#33 [CL3]	–	–	–
#22 [CL3]	–	–	–
#52 [CL4]	13.3 ± 4.1	11.3	12.5
#49 [CL4]	–	–	–
#104 [CL5]	–	–	–
#44 [CL4]	7.3 ± 2.4	5.63	6.58
#37 [CL3]	–	–	–
#74 [CL4]	–	–	–
#70 [CL4]	–	–	–
#95 [CL5]	–	–	–
#155 [CL6]	–	–	–
#101 [CL5]	24.6 ± 6.0	19.9	26.6
#99 [CL5]	–	–	–
#119 [CL5]	–	–	–
#87 [CL5]	9.6 ± 1.4	8.53	10.9
#110 [CL5]	33.3 ± 11.9	23.9	31.6
#151 [CL6]	–	–	–
#149 [CL6]	–	–	–
#123 [CL5]	–	–	–
#118 [CL5]	17.0 ± 7.4	18.1	19.7
#114 [CL5]	–	–	–
#188 [CL7]	–	–	–
#153 [CL6] + #168	27.2 ± 5.5	25.4	23.7
#105 [CL5]	7.6 ± 2.7	6.41	5.69
#138 [CL6] + #158	28.6 ± 9.1	27.9	34.0
#178 [CL7]	–	–	–
#187 [CL7]	–	–	–
#183 [CL7]	7.2 ± 2.8	7.48	8.02
#128 [CL6]	5.5 ± 2.3	3.96	5.65
#167 [CL6]	–	–	–
#177 [CL7]	–	–	–
#202 [CL8]	–	–	–
#171 [CL7]	–	–	–
#156 [CL6]	–	–	–
#201 [CL8]	–	–	–
#157 [CL5]	–	–	–
#180 [CL7]	22.3 ± 7.6	23.1	28.0

13

Cont. table 4.1.2

QA/QC DATA REPORT for congeners of PCB in sediment

Compound	Certified Reference Materials of NWRI EC-5 Reference Value, ng/g	Detected, ng/g	
		SMS 01	SMS 09
#191 [CL7]	–	–	–
#170 [CL7]	10.1 ± 1.6	8.65	10.9
#199 [CL8]	–	–	–
#189 [CL7]	–	–	–
#208 [CL9]	–	–	–
#194 [CL8]	8.1 ± 10.1	8.49	12.0
#205 [CL9]	–	–	–
#206 [CL9]	2.2 ± 0.9	2.98	2.11
#209 [CL10]	1.2 ± 0.9	1.28	1.25
		Surrogate Internal Standards, % Recovery	
#28 [CL3] C^{13}	–	*86*	*124*
#52 [CL4] C^{13}	–	*66*	*97*
#101 [CL5] C^{13}	–	*66*	*101*
#153 [CL6] C^{13}	–	*73*	*98*
#138 [CL6] C^{13}	–	*77*	*93*
#180 [CL7] C^{13}	–	*91*	*111*
#209 [CL10] C^{13}	–	*89*	*121*

14

Table 4.2

QA/QC DATA REPORT for congeners of PCB in biota

Compound	Procedural Blank PBB06, ng/g	Method Detection Limit, ng/g	Duplicate Difference, %D	IAEA-406, ng/g		
				Detected	Concent-ration	Confidence Interval
#1 [CL1]	n.d.	0.10	–	–	–	–
#3 [CL1]	n.d.	0.10	–	–	–	–
#4/#10 [CL2]	n.d.	0.10	–	–	–	–
#8 [CL2]	n.d.	0.10	–	–	–	–
#19 [CL3]	n.d.	0.10	–	–	–	–
#17/#18 [CL3]	n.d.	0.10	–	0.93	0.38	0.11-0.93
#28/#31 [CL3]	0.30	0.10	–	0.69	0.86	0.66-1.77
#54 [CL4]	n.d.	0.10	–	–	–	–
#33 [CL3]	n.d.	0.10	–	–	–	–
#22 [CL3]	n.d.	0.10	–	–	–	–
#52 [CL4]	n.d.	0.10	18	1.93	1.30	1.00-2.20
#49 [CL4]	n.d.	0.10	–	0.42	0.41	0.36-0.44
#104 [CL5]	n.d.	0.10	–	–	–	–
#44 [CL4]	n.d.	0.10	–	0.50	0.46	0.46-0.52
#37 [CL3]	n.d.	0.10	–	–	–	–
#74 [CL4]	n.d.	0.10	–	–	–	–
#70 [CL4]	n.d.	0.10	–	–	–	–
#95 [CL5]	n.d.	0.10	–	1.19	1.10	1.00-1.20
#155 [CL6]	n.d.	0.10	–	–	–	–
#101 [CL5]	n.d.	0.10	4	2.49	3.10	2.20-3.40
#99 [CL5]	n.d.	0.10	15	1.13	0.91	0.89-1.20
#119 [CL5]	n.d.	0.10	–	–	–	–
#87 [CL5]	n.d.	0.10	–	1.08	0.82	0.69-1.40
#110 [CL5]	n.d.	0.10	8	1.60	1.40	1.30-2.00
#151 [CL6]	n.d.	0.10	–	0.69	0.67	0.62-0.75
#149 [CL6]	n.d.	0.10	–	2.01	2.00	1.70-2.40
#188 [CL7]	n.d.	0.10	–	–	–	–
#153/#168 [CL6]	n.d.	0.10	25	3.59	3.70	2.90-6.00
#138/#158 [CL6]	n.d.	0.10	6	2.88	4.00	2.50-6.30
#178 [CL7]	n.d.	0.10	–	–	–	–
#187 [CL7]	n.d.	0.15	–	0.98	1.10	0.96-1.20
#183 [CL7]	n.d.	0.15	–	0.31	0.32	0.28-0.35
#128 [CL6]	n.d.	0.15	–	0.61	0.80	0.51-1.40
#177 [CL7]	n.d.	0.15	–	0.17	0.18	0.16-0.19
#202 [CL8]	n.d.	0.15	–	–	–	–
#171 [CL7]	n.d.	0.15	–	–	–	–
#201 [CL8]	n.d.	0.15	–	0.09	0.12	0.07-0.23
#191 [CL7]	n.d.	0.15	–	–	–	–
#199 [CL8]	n.d.	0.15	–	0.12	0.16	0.013-0.17
#208 [CL9]	n.d.	0.15	–	–	–	–
#194 [CL8]	n.d.	0.15	–	0.19	0.13	0.10-0.25
#205 [CL9]	n.d.	0.15	–	–	–	–
#206 [CL9]	n.d.	0.15	–	0.20	0.05	0.03-3.10
#209 [CL10]	n.d.	0.15	–	0.82	0.07	0.07-1.10

15

Cont. table 4.2

QA/QC DATA REPORT for congeners of PCB in biota

Compound	Procedural Blank PBB06, ng/g	Method Detection Limit, ng/g	Duplicate Difference, %D	IAEA-406, ng/g		
				Detected	Concent-ration	Confidence Interval
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*		
#28 [CL3] C^{13}	*74*	0.02	–	*78*		
#52 [CL4] C^{13}	*78*	0.02	–	*73*		
#101 [CL5] C^{13}	*77*	0.02	–	*70*		
#153 [CL6] C^{13}	*73*	0.02	–	*85*		
#138 [CL6] C^{13}	*63*	0.02	–	*81*		
#180 [CL7] C^{13}	*85*	0.02	–	*111*		

16

Table 4.3

QA/QC DATA REPORT for planar and mono-orthosubstituted congeners of PCB in biota

Compound	Procedural Blank PBB02, ng/g	Method Detection Limit, ng/g	Duplicate Difference, %D	IAEA-406, ng/g		
				Detected	Concent-ration	Confidence Interval
#CL4 81	n.d.	0.01	–	–	–	–
#CL4 77	n.d.	0.01	–	–	–	–
#CL5 123	n.d.	0.04	–	–	–	–
#CL5 118	0.48	0.20	25	2.38	2.5	1.9-3.7
#CL5 114	n.d.	0.01	–	–	–	–
#CL5 105	0.27	0.10	–	0.65	0.71	0.48-0.88
#CL5 126	n.d.	0.01	–	–	–	–
#CL6 167	n.d.	0.01	–	–	–	–
#CL6 156	n.d.	0.03	–	0.53	0.27	0.21-0.59
#CL6 157	n.d.	0.01	–	–	–	–
#CL6 169	n.d.	0.01	–	–	–	–
#CL7 180	n.d.	0.05	7	1.08	1.2	1-1.2
#CL7 170	n.d.	0.02	–	0.55	0.54	0.38-0.81
#CL7 189	n.d.	0.01	–	–	–	–
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*		
#CL4 81 C^{13}	*111*	0.005	–	*108*		
#CL4 77 C^{13}	*124*	0.005	–	*123*		
#CL5 123 C^{13}	*95*	0.005	–	*90*		
#CL5 118 C^{13}	*89*	0.005	–	*84*		
#CL5 114 C^{13}	*77*	0.005	–	*71*		
#CL5 105 C^{13}	*114*	0.005	–	*100*		
#CL5 126 C^{13}	*117*	0.005	–	*118*		
#CL6 167 C^{13}	*112*	0.005	–	*106*		
#CL6 156 C^{13}	*119*	0.005	–	*120*		
#CL6 157 C^{13}	*115*	0.005	–	*119*		
#CL6 169 C^{13}	*122*	0.005	–	*118*		
#CL7 180 C^{13}	*95*	0.005	–	*98*		
#CL7 170 C^{13}	*115*	0.005	–	*121*		
#CL7 189 C^{13}	*100*	0.005	–	*108*		

Table 4.4.1

QA/QC DATA REPORT for Chlorinated Pesticides in sediment

Compound	Method Detection Limit, ng/g	Procedural Blank PBS01, ng/g	Procedural Blank PBS08, ng/g	Procedural Blank PBS09, ng/g	Duplicate Difference, %D	
					PAS 12	PAS 35
HCB	0.03	n.d.	n.d.	n.d.	–	–
α-HCH	0.05	n.d.	n.d.	n.d.	–	–
β-HCH	0.05	n.d.	n.d.	n.d.	–	–
γ-HCH	0.05	n.d.	n.d.	n.d.	–	–
Heptachlor	0.05	n.d.	n.d.	n.d.	–	–
Heptachlor epoxide	0.10	n.d.	n.d.	n.d.	–	–
Oxychlordane	0.08	n.d.	n.d.	n.d.	–	–
trans-Chlordane	0.03	n.d.	n.d.	n.d.	–	–
cis-Chlordane	0.03	n.d.	n.d.	n.d.	–	–
trans-Nonachlor	0.01	n.d.	n.d.	n.d.	–	–
cis-Nonachlor	0.01	n.d.	n.d.	n.d.	–	–
2,4`-DDE	0.03	n.d.	n.d.	n.d.	–	–
4,4`-DDE	0.03	n.d.	n.d.	0.17	18	–
2,4`-DDD	0.03	n.d.	n.d.	n.d.	–	–
4,4`-DDD	0.03	n.d.	n.d.	n.d.	–	–
2,4`-DDT	0.08	n.d.	n.d.	n.d.	–	–
4,4`-DDT	0.08	n.d.	n.d.	n.d.	–	–
Endrin	0.10	n.d.	n.d.	n.d.	–	–
Dieldrin	0.05	n.d.	n.d.	n.d.	–	–
Mirex	0.03	n.d.	n.d.	n.d.	–	–
		Surrogate Internal Standards, % Recovery				
HCB C^{13}	0.005	*66*	*60*	*79*	–	–
γ-HCH C^{13}	0.005	*60*	*52*	*76*	–	–
4,4`-DDE C^{13}	0.005	*61*	*89*	*66*	–	–
4,4`-DDT C^{13}	0.010	*76*	*71*	*77*	–	–

Table 4.4.2

QA/QC DATA REPORT for Chlorinated Pesticides in sediment

Compound	Quality Control Standards Lot No. 324, ng/g		Detected, ng/g	
	Certified Value	Advisory Range	SMS01	SMS09
HCB	–	–	–	–
α-HCH	–	–	–	–
β-HCH	145	25-213	56.6	66.7
γ-HCH	219	70-178	167.0	73.9
Heptachlor	297	101-330	227.0	214.0
Heptachlor epoxide	–	–	–	–
Oxychlordane	–	–	–	–
trans-Chlordane	–	–	–	–
cis-Chlordane	–	–	–	–
trans-Nonachlor	–	–	–	–
cis-Nonachlor	–	–	–	–
2,4`-DDE	–	–	–	–
4,4`-DDE	455	187-660	194.0	197.0
2,4`-DDD	–	–	–	–
4,4`-DDD	334	104-471	150.0	128.0
2,4`-DDT	–	–	–	–
4,4`-DDT	287	72-459	74.7	75.4
Endrin	407	122-598	171.0	206.0
Dieldrin	101	36-147	118.0	96.0
Mirex	–	–	–	–
			Surrogate Internal Standards, % Recovery	
HCB C^{13}	–		*74*	*75*
γ-HCH C^{13}	–		*71*	*70*
4,4`-DDE C^{13}	–		*80*	*119*
4,4`-DDT C^{13}	–		*85*	*100*

19

Table 4.5

QA/QC DATA REPORT for Chlorinated Pesticides in biota

Compound	Procedural Blank PBB06, ng/g	Method Detection Limit, ng/g	Duplicate Difference, %D	IAEA-406, ng/g		
				Detected	Concent-ration	Confidence Interval
HCB	n.d.	0.05	21	1.95	1.5	0.95-2
α-HCH	n.d.	0.03	–	1.01	0.79	0.23-1.7
β-HCH	n.d.	0.03	–	1.20	0.75	0.2-2.3
γ-HCH	n.d.	0.03	–	0.78	0.27	0.11-0.8
Heptachlor	n.d.	0.05	–	0.25	0.32	0.23-0.46
Heptachlor epoxide	n.d.	0.10	–	0.56	0.99	0.37-1.6
Oxychlordane	n.d.	0.08	–	–	–	–
trans-Chlordane	n.d.	0.03	–	0.73	0.7	0.63-1
cis-Chlordane	n.d.	0.03	–	2.25	2.8	2-4.1
trans-Nonachlor	n.d.	0.01	–	4.09	4.1	3.9-4.1
cis-Nonachlor	n.d.	0.01	–	1.23	0.86	0.77-1.4
2,4`-DDE	n.d.	0.03	–	0.55	0.76	0.48-1.3
4,4`-DDE	n.d.	0.03	23	6.22	9.2	6.2-11
2,4`-DDD	n.d.	0.03	–	0.55	0.88	0.43-3
4,4`-DDD	n.d.	0.03	–	2.68	2.8	2-3.7
2,4`-DDT	n.d.	0.08	–	1.02	2.9	0.9-4.4
4,4`-DDT	n.d.	0.08	–	2.39	3	1.8-5.6
Endrin	n.d.	0.10	–	0.95	1.9	0.86-5.1
Dieldrin	n.d.	0.05	–	2.52	3.5	1.4-1.7
Mirex	n.d.	0.03	–	–	–	–
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*		
HCB C^{13}	*69*	0.005	–	*60*		
γ-HCH C^{13}	*61*	0.005	–	*68*		
4,4`-DDE C^{13}	*77*	0.005	–	*69*		
4,4`-DDT C^{13}	*61*	0.005	–	*112*		

20

Table 4.6

QA/QC DATA REPORT for Polycyclic Aromatic Hydrocarbons in sediment

Compound	Procedural Blank PBS25, ng/g	Method Detection Limit, ng/g	Duplicate Diffe-rence, %D	Certified Reference Materials of NWRI EC-5 Reference Value, ng/g	
				Detected	Reference Value
Naphthalene	16.0	10.0	9	23.3	26±6
1-Methylnaphtalene	5.70	5.00	12	–	–
2-Methylnaphtalene	n.d.	5.00	15	–	–
C2-Naphthalenes	n.d.	5.00	11	–	–
C3-Naphthalenes	n.d.	10.0	25	–	–
C4-Naphthalenes	n.d.	10.0	–	–	–
Acenaphthylene	n.d.	0.30	2	46.8	41±9
Acenaphthene	n.d.	0.30	–	27.9	29±9
Fluorene	n.d.	0.30	4	67.4	84±26
C1-Fluorenes	n.d.	0.50	–	–	–
C2-Fluorenes	n.d.	0.50	–	–	–
C3-Fluorenes	n.d.	0.70	–	–	–
Phenanthrene	n.d.	1.00	13	632.0	612±57
Anthracene	n.d.	0.50	24	125.0	113±17
C1-Phenans/Anths	n.d.	0.60	–	–	–
C2-Phenans/Anths	n.d.	0.60	–	–	–
C3-Phenans/Anths	n.d.	0.70	–	–	–
C4-Phenans/Anths	n.d.	0.70	–	–	–
Dibenzothiophene	n.d.	0.3	–	–	–
C1-Dibenzothiophenes	n.d.	0.5	–	–	–
C2-Dibenzothiophenes	n.d.	0.5	–	–	–
C3-Dibenzothiophenes	n.d.	0.7	–	–	–
Fluoranthene	n.d.	0.50	5	896.0	823±74
Pyrene	n.d.	0.50	–	933.0	987±134
C1-Flanths/Pyrs	n.d.	0.60	–	–	–
C2-Flanths/Pyrs	n.d.	0.60	–	–	–
C3-Flanths/Pyrs	n.d.	0.80	–	–	–
Benzo(a)anthracene	n.d.	0.50	–	541.0	503±47
Chrysene	n.d.	0.50	–	663.0	619±60
C1-Chrysenes	n.d.	0.70	–	–	–
C2-Chrysenes	n.d.	0.70	–	–	–
C3-Chrysenes	n.d.	1.00	–	–	–
Benzo(b)fluoranthene	n.d.	1.00	–	429.0	480±88
Benzo(k)fluoranthene	n.d.	1.00	–	400.0	419±49
Benzo(e)pyrene	n.d.	1.00	–	464.0	440±76
Benzo(a)pyrene	n.d.	1.00	–	423.0	449±61
Perylene	n.d.	1.00	21	202.0	187±28
Indeno(1,2,3-c,d) pyrene	n.d.	1.50	–	327.0	386±66
Dibenz(a,h)antracene	n.d.	1.50	–	162.0	195±44
Benzo(g,h,i)perylene	n.d.	1.50	–	380.0	333±53
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*	
Naphthalene d_8	*64*	0.05	–	*61*	
Acenaphthene d_{10}	*64*	0.05	–	*73*	
Phenanthrene d_{10}	*75*	0.05	–	*102*	
Chrysene d_{12}	*73*	0.05	–	*119*	
Perylene d_{12}	*79*	0.10	–	*77*	

21

Table 4.7

QA/QC DATA REPORT for Polycyclic Aromatic Hydrocarbons in biota

Compound	Procedural Blank PBB02, ng/g	Method Detection Limit, ng/g	Duplicate Difference, %D	Spiked Blank Sample SMB02		
				Detected, ng	Added, ng	% Recovery
Naphthalene	21.0	15.0	–	820.0	1000	*82*
1-Methylnaphtalene	7.07	6.00	–	–	–	–
2-Methylnaphtalene	10.0	6.00	–	–	–	–
C2-Naphthalenes	8.99	6.00	–	–	–	–
C3-Naphthalenes	13.6	10.0	–	–	–	–
C4-Naphthalenes	n.d.	10.0	–	–	–	–
Acenaphthylene	n.d.	0.70	–	840.0	1000	*84*
Acenaphthene	n.d.	0.70	–	780.0	1000	*78*
Fluorene	n.d.	0.70	–	750.0	1000	*75*
C1-Fluorenes	n.d.	1.00	–	–	–	–
C2-Fluorenes	n.d.	1.00	–	–	–	–
C3-Fluorenes	n.d.	1.00	–	–	–	–
Phenanthrene	1.63	1.00	–	760.0	1000	*76*
Anthracene	0.77	0.50	–	950.0	1000	*95*
C1-Phenans/Anths	0.66	0.60	–	–	–	–
C2-Phenans/Anths	n.d.	0.60	–	–	–	–
C3-Phenans/Anths	n.d.	0.70	–	–	–	–
C4-Phenans/Anths	n.d.	0.70	–	–	–	–
Dibenzothiophene	n.d.	0.30	–	–	–	–
C1-Dibenzothiophenes	n.d.	0.50	–	–	–	–
C2-Dibenzothiophenes	n.d.	0.50	–	–	–	–
C3-Dibenzothiophenes	n.d.	0.70	–	–	–	–
Fluoranthene	1.00	0.50	–	880.0	1000	*88*
Pyrene	1.05	0.50	–	800.0	1000	*80*
C1-Flanths/Pyrs	n.d.	0.60	–	–	–	–
C2-Flanths/Pyrs	n.d.	0.60	–	–	–	–
C3-Flanths/Pyrs	n.d.	0.80	–	–	–	–
Benzo(a)anthracene	n.d.	0.50	–	810.0	1000	*81*
Chrysene	n.d.	0.50	–	740.0	1000	*74*
C1-Chrysenes	n.d.	0.70	–	–	–	–
C2-Chrysenes	n.d.	0.70	–	–	–	–
C3-Chrysenes	n.d.	1.00	–	–	–	–
Benzo(b)fluoranthene	n.d.	1.00	–	830.0	1000	*83*
Benzo(k)fluoranthene	n.d.	1.00	–	850.0	1000	*85*
Benzo(e)pyrene	n.d.	1.00	–	–	–	–
Benzo(a)pyrene	n.d.	1.00	–	790.0	1000	*79*
Perylene	n.d.	1.50	–	–	–	–
Indeno(1,2,3-c,d) pyrene	n.d.	1.50	–	770.0	1000	*77*
Dibenz(a,h)antracene	n.d.	1.50	–	870.0	1000	*87*
Benzo(g,h,i)perylene	n.d.	1.50	–	800.0	1000	*80*
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*		
Naphthalene d_8	*64*	0.05	–	*60*		
Acenaphthene d_{10}	*68*	0.05	–	*65*		
Phenanthrene d_{10}	*68*	0.05	–	*71*		
Chrysene d_{12}	*77*	0.05	–	*70*		
Perylene d_{12}	*79*	0.10	–	*79*		

22

Table 4.8.1

QA/QC DATA REPORT for Polybrominated diphenyl ethers in sediment

Compound	Method Detection Limit, ng/kg	Procedural Blank PBS01, ng/kg	Procedural Blank PBS02, ng/kg	Procedural Blank PBS03, ng/kg	Duplicate Difference, %D	
					PAS 12	PAS 35
TriBDE #17	1.00	n.d.	n.d.	n.d.	–	–
TriBDE #28	1.00	n.d.	n.d.	n.d.	–	18
TeBDE #49	1.00	n.d.	n.d.	n.d.	–	–
TeBDE #71	1.00	n.d.	n.d.	n.d.	–	–
TeBDE #47	8.00	n.d.	n.d.	n.d.	10	5
TeBDE #66	1.00	n.d.	n.d.	n.d.	–	5
PeBDE #100	1.00	n.d.	n.d.	n.d.	3	18
PeBDE #99	1.00	2.46	1.83	3.50	20	10
PeBDE #85	3.00	n.d.	n.d.	n.d.	–	–
HexBDE #154	3.00	n.d.	n.d.	n.d.	–	8
HexBDE #153	3.00	n.d.	n.d.	n.d.	21	13
HexBDE #138	3.00	n.d.	n.d.	n.d.	–	–
HepBDE #183	5.00	n.d.	n.d.	n.d.	–	–
HepBDE #190	5.00	n.d.	n.d.	n.d.	–	–
NoBDE #208	10.0	n.d.	n.d.	n.d.	–	–
NoBDE #207	10.0	n.d.	n.d.	n.d.	–	–
NoBDE #206	10.0	n.d.	n.d.	n.d.	–	–
DeBDE #209	10.0	n.d.	n.d.	n.d.	–	–

Table 4.8.2

QA/QC DATA REPORT for Polybrominated diphenyl ethers in sediment

Compound	Sludge Reference Material IIS-01-1 Median Value, ng/kg	Detected, ng/kg	% REC	Detected, ng/kg	% REC	Detected, ng/kg	% REC
		SMS01		SMS 02		SMS03	
TriBDE #17	–	–	–	–	–	–	–
TriBDE #28	1970	1576	*80*	1418	*72*	1596	*81*
TeBDE #49	3370	2966	*88*	2662	*79*	2460	*73*
TeBDE #71	761	563	*74*	632	*83*	563	*74*
TeBDE #47	123200	94864	*77*	97328	*79*	94864	*77*
TeBDE #66	–	–	–	–	–	–	–
PeBDE #100	29000	23200	*80*	27550	*95*	29580	*102*
PeBDE #99	150000	106500	*71*	120000	*80*	111000	*74*
PeBDE #85	–	–	–	–	–	–	–
HexBDE #154	12800	10752	*84*	14080	*110*	12672	*99*
HexBDE #153	18400	14904	*81*	20608	*112*	19136	*104*
HexBDE #138	–	–	–	–	–	–	–
HepBDE #183	9430	6695	*71*	11599	*123*	10845	*115*
HepBDE #190	–	–	–	–	–	–	–
NoBDE #208	–	–	–	–	–	–	–
NoBDE #207	–	–	–	–	–	–	–
NoBDE #206	12300	10086	*82*	11070	*90*	10578	*86*
DeBDE #209	364000	338520	*93*	338520	*93*	316680	*87*

23

Table 4.9

QA/QC DATA REPORT for Polybrominated diphenyl ethers in biota

Compound	Procedural Blank PBB08, ng/kg	Method Detection Limit, ng/kg	Duplicate Difference, %D	Spiked Blank Sample SMB08		
				Detected, ng	Added, ng	% Recovery
TriBDE #17	n.d.	1.00	–	–	–	–
TriBDE #28	n.d.	1.00	–	0.49	0.60	*82*
TeBDE #49	n.d.	1.00	–	1.70	2.00	*85*
TeBDE #71	n.d.	1.00	–	–	–	–
TeBDE #47	n.d.	8.00	2	0.47	0.60	*79*
TeBDE #66	n.d.	1.00	–	–	–	–
PeBDE #100	n.d.	1.00	8	–	–	–
PeBDE #99	n.d.	1.00	21	0.46	0.60	*76*
PeBDE #85	n.d.	3.00	–	–	–	–
HexBDE #154	n.d.	3.00	–	–	–	–
HexBDE #153	n.d.	3.00	–	0.46	0.60	*77*
HexBDE #138	n.d.	3.00	–	–	–	–
HepBDE #183	n.d.	5.00	–	–	–	–
HepBDE #190	n.d.	5.00	–	–	–	–
NoBDE #208	n.d.	10.0	–	1.82	2.00	*91*
NoBDE #207	n.d.	10.0	–	–	–	–
NoBDE #206	n.d.	10.0	–	1.70	2.00	*85*
DeBDE #209	n.d.	10.0	–	8.00	10.0	*80*

24

Table 4.10

QA/QC DATA REPORT for Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in sediment

Compound	Procedural Blank PBS05, ng/kg	Method Detection Limit, ng/kg	Duplicate Difference, %D	Spiked Blank Sample SMS05		
				Detected, ng	Added, ng	% Recovery
2,3,7,8-TCDD	n.d.	1.00	–	0.03	0.04	*78*
1,2,3,7,8-PeCDD	n.d.	0.20	–	0.15	0.20	*76*
1,2,3,4,7,8-HxCDD	n.d.	0.10	–	0.16	0.20	*79*
1,2,3,6,7,8- HxCDD	n.d.	0.10	–	0.17	0.20	*84*
1,2,3,7,8,9- HxCDD	n.d.	0.10	–	0.17	0.20	*85*
1,2,3,4,6,7,8-HpCDD	n.d.	0.10	15	0.19	0.20	*96*
OCDD	n.d.	0.10	4	0.32	0.40	*79*
2,3,7,8-TCDF	n.d.	0.20	4	0.03	0.04	*80*
1,2,3,7,8-PeCDF	n.d.	0.20	23	0.15	0.20	*74*
2,3,4,7,8-PeCDF	n.d.	0.20	2	0.19	0.20	*96*
1,2,3,4,7,8-HxCDF	n.d.	0.10	–	0.20	0.20	*102*
1,2,3,6,7,8- HxCDF	n.d.	0.10	–	0.17	0.20	*85*
2,3,4,6,7,8-HxCDF	n.d.	0.10	–	0.17	0.20	*87*
1,2,3,7,8,9-HxCDF	n.d.	0.10	–	0.20	0.20	*99*
1,2,3,4,6,7,8-HpCDF	n.d.	0.10	13	0.17	0.20	*85*
1,2,3,4,7,8,9-HpCDF	n.d.	0.10	–	0.16	0.20	*80*
OCDF	n.d.	0.10	9	0.33	0.40	*82*
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*		
($^{13}C_{12}$)2,3,7,8-TCDD	*85*	1.00	–	*91*		
($^{13}C_{12}$)2,3,7,8-TCDF	*82*	0.20	–	*85*		
($^{13}C_{12}$)1,2,3,7,8-PeCDD	*84*	0.20	–	*78*		
($^{13}C_{12}$)1,2,3,7,8-PeCDF	*87*	0.20	–	*74*		
($^{13}C_{12}$)1,2,3,6,7,8- HxCDD	*80*	0.10	–	*86*		
($^{13}C_{12}$)1,2,3,6,7,8- HxCDF	*90*	0.10	–	*81*		
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDD	*79*	0.10	–	*80*		
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDF	*77*	0.10	–	*99*		
($^{13}C_{12}$)OCDD	*80*	0.10	–	*88*		

Table 4.11

QA/QC DATA REPORT for Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in biota

Compound	Procedural Blank PBB08, ng/kg	Method Detection Limit, ng/kg	Duplicate Difference, %D	Spiked Blank Sample SMB08		
				Detected, ng	Added, ng	% Recovery
2,3,7,8-TCDD	n.d.	1.00	–	0.03	0.04	*86*
1,2,3,7,8-PeCDD	n.d.	0.20	–	0.19	0.20	*94*
1,2,3,4,7,8-HxCDD	n.d.	0.10	–	0.17	0.20	*85*
1,2,3,6,7,8- HxCDD	n.d.	0.10	–	0.17	0.20	*87*
1,2,3,7,8,9- HxCDD	n.d.	0.10	–	0.15	0.20	*77*
1,2,3,4,6,7,8-HpCDD	n.d.	0.10	–	0.18	0.20	*89*
OCDD	n.d.	0.10	–	0.36	0.40	*90*
2,3,7,8-TCDF	n.d.	0.20	–	0.03	0.04	*85*
1,2,3,7,8-PeCDF	n.d.	0.20	8	0.15	0.20	*76*
2,3,4,7,8-PeCDF	n.d.	0.20	–	0.19	0.20	*94*
1,2,3,4,7,8-HxCDF	n.d.	0.10	–	0.18	0.20	*91*
1,2,3,6,7,8- HxCDF	n.d.	0.10	–	0.17	0.20	*85*
2,3,4,6,7,8-HxCDF	n.d.	0.10	–	0.16	0.20	*81*
1,2,3,7,8,9-HxCDF	n.d.	0.10	–	0.16	0.20	*82*
1,2,3,4,6,7,8-HpCDF	n.d.	0.10	25	0.16	0.20	*80*
1,2,3,4,7,8,9-HpCDF	n.d.	0.10	–	0.16	0.20	*78*
OCDF	n.d.	0.10	–	0.31	0.40	*77*
Surrogate Internal Standards, % Recovery				*Surrogate Internal Standards, % Recovery*		
($^{13}C_{12}$)2,3,7,8-TCDD	*75*	1.00	–	*88*		
($^{13}C_{12}$)2,3,7,8-TCDF	*78*	0.20	–	*84*		
($^{13}C_{12}$)1,2,3,7,8-PeCDD	*73*	0.20	–	*79*		
($^{13}C_{12}$)1,2,3,7,8-PeCDF	*79*	0.20	–	*79*		
($^{13}C_{12}$)1,2,3,6,7,8- HxCDD	*80*	0.10	–	*96*		
($^{13}C_{12}$)1,2,3,6,7,8- HxCDF	*85*	0.10	–	*92*		
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDD	*94*	0.10	–	*92*		
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDF	*96*	0.10	–	*85*		
($^{13}C_{12}$)OCDD	*80*	0.10	–	*84*		

Table 4.12.1

QA/QC DATA REPORT for Toxaphenes in sediment

Compound	Method Detection Limit, ng/kg	Procedural Blank PBS01, ng/kg	Procedural Blank PBS08, ng/kg	Procedural Blank PBS09, ng/kg	Duplicate Difference, %D	
					PAS12	PAS35
Parl 26	0.10	n.d.	n.d.	n.d.	–	–
Parl 50	0.20	n.d.	n.d.	n.d.	–	–
Parl 62	2.00	n.d.	n.d.	n.d.	–	–

Table 4.12.2

QA/QC DATA REPORT for Toxaphenes in sediment

Compound	Spiked Blank Sample Added, ng	Detected, ng	% Recovery	Detected, ng	% Recovery
		SMS01		SMS09	
Parl 26	8.43	6.91	*82*	6.32	*75*
Parl 50	8.43	7.08	*84*	6.58	*78*
Parl 62	8.43	6.49	*77*	6.41	*76*

Table 4.13

QA/QC DATA REPORT for Toxaphenes in biota

Compound	Procedural Blank PBB06, ng/kg	Method Detection Limit, ng/kg	Duplicate Difference, %D	Spiked Blank Sample SMB06		
				Detected, ng	Added, ng	% Recovery
Parl 26	n.d.	0.30	13	6.41	8.43	*76*
Parl 50	n.d.	0.30	15	7.17	8.43	*85*
Parl 62	n.d.	2.00	–	7.08	8.43	*84*

Table 4.14

QA/QC DATA REPORT for Metals in sediment

Metals	Procedural Blank, mg/kg	Duplicate Difference, % D	Matrix Spike Recovery, % R	Detection Limit, mg/kg	Marine sediment reference materials, Mess-3, mg/kg	
					Certified Value	Detected Value
As	< 0.50	8.0	92.3	0.50	21.1 ± 1.1	22.1
Cd	0.011	12.5	95.0	0.005	0.24 ± 0.01	0.22
Co	< 5.00	4.7	89.6	5.00	14.4 ± 2.0	13.6
Cr	< 5.00	13.3	96.4	5.00	105 ± 4	90.8
Cu	< 2.00	1.3	95.4	2.00	33.9 ±1.6	32.2
Hg	< 0.005	12.4	92.7	0.005	0.091 ± 0.009	0.080
Ni	< 5.00	14.6	85.9	5.00	46.9 ± 2.2	49.6
Pb	< 8.00	4.0	95.8	8.00	21.1 ± 0.7	22.0
Se	< 0.10	15.3	90.6	0.10	0.72 ± 0.05	0.62
Zn	< 0.80	5.3	111	0.80	159 ± 8	149

Table 4.15

QA/QC DATA REPORT for Metals in biota

Metals	Procedural Blank, mg/kg	Duplicate Difference, % D	Matrix Spike Recovery, % R	Detection Limit, mg/kg	Certified Reference Material, DORM-2, mg/kg	
					Certified Value	Detected Value
As	< 0.20	19.0	83.4	0.20	18.0 ± 1.1	16.0
Cd	0.0006	0	87.9	0.0004	0.043 ± 0.008	0.033
Co	< 0.010	0	90.0	0.010	0.182 ± 0.031	0.140
Cr	< 0.010	11.3	87.5	0.010	34.7 ± 5.5	28.8
Cu	0.040	9.3	97.7	0.010	2.34 ± 0.16	2.07
Hg	< 0.003	4.2	91.3	0.003	4.64 ± 0.26	4.21
Ni	< 0.010	0	89.5	0.010	19.4 ± 3.1	14.4
Pb	0.010	18.2	111	0.010	0.065 ± 0.007	0.080
Se	< 0.20	16.7	89.6	0.20	1.40 ± 0.09	1.22
Zn	< 0.10	0.2	95.8	0.10	25.6 ± 2.3	24.0

Annex – Results of analysis

Table A.1.1

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Holmevatn (72), Nordland, Norway (1-0)	Valnesvatn (210), Nordland, Norway (0-1)	Vikvatn (224), Nordland, Norway (0-1)	Strumpvatn (226), Nordland (0-1)	Storvatn (227), Nordland, Norway (0-1)
Lab Code:	PAS 01	PAS 02	PAS 03	PAS 04	PAS 05
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#28/#31 [CL3]	**0.72**	**0.57**	**0.26**	**0.34**	**0.16**
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	n.d.	n.d.	n.d.	**0.07**	n.d.
#49 [CL4]	n.d.	n.d.	n.d.	n.d.	**1.02**
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	**0.23**	**0.12**	n.d.	n.d.	**0.74**
#70 [CL4]	**0.30**	**2.27**	n.d.	n.d.	**2.03**
#95 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**0.55**	n.d.	**0.26**	**0.33**	**0.71**
#99 [CL5]	**0.40**	n.d.	n.d.	**0.20**	**0.52**
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#110 [CL5]	**0.65**	**0.45**	**0.51**	**0.35**	**1.28**
#151 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#149 [CL6]	**0.64**	**0.22**	n.d.	**0.17**	**0.42**
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#118 [CL5]	**0.65**	**0.23**	**0.39**	**0.26**	**1.19**
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**0.27**	**0.42**	**0.27**	**0.32**	**0.84**
#105 [CL5]	n.d.	n.d.	n.d.	**0.24**	**0.57**
#138/#158 [CL6]	**0.20**	**0.11**	**0.35**	**0.29**	**0.59**

29 30

Cont. table A.1.1

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Holmevatn (72), Nordland, Norway (1-0)	Valnesvatn (210), Nordland, Norway (0-1)	Vikvatn (224), Nordland, Norway (0-1)	Strumpvatn (226), Nordland (0-1)	Storvatn (227), Nordland, Norway (0-1)
Lab Code:	PAS 01	PAS 02	PAS 03	PAS 04	PAS 05
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#128 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#167 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#171 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#156 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#180 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PCB`s	**4.61**	**4.39**	**2.04**	**2.57**	**10.1**
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	*84*	*80*	*43*	*88*	*84*
#52 [CL4] C^{13}	*65*	*64*	*36*	*68*	*70*
#101 [CL5] C^{13}	*66*	*63*	*48*	*74*	*73*
#153 [CL6] C^{13}	*67*	*67*	*61*	*73*	*75*
#138 [CL6] C^{13}	*67*	*63*	*65*	*79*	*74*
#180 [CL7] C^{13}	*86*	*80*	*91*	*92*	*91*
#209 [CL10] C^{13}	*98*	*30*	*150*	*102*	*116*
Weight, g	1.55	2.00	2.10	2.07	2.19

Table A.1.2

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Storvatnet (232), Nordland, Norway (0-1)	Skovatn (235), Troms, Norway (0-1)	Kapervatn (236), Troms, Norway (0-1)	Storvatn (242), Troms, Norway (0-1)	Peder Sorensens vatn (245), Troms, Norway (0-1)
Lab Code:	PAS 06	PAS 07	PAS 08	PAS 09	PAS 10
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#28/#31 [CL3]	**0.33**	**0.36**	**0.29**	**0.22**	**0.52**
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#49 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	**0.15**	n.d.	n.d.	n.d.	n.d.
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	**0.12**	**0.13**	n.d.	**0.08**	n.d.
#70 [CL4]	**0.25**	**0.73**	**0.26**	**0.23**	n.d.
#95 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**0.25**	**0.29**	n.d.	**0.24**	**0.35**
#99 [CL5]	**0.19**	**0.22**	n.d.	**0.17**	n.d.
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	**0.13**	n.d.	n.d.	n.d.	n.d.
#110 [CL5]	**0.31**	**0.31**	n.d.	**0.36**	**0.34**
#151 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#149 [CL6]	**0.13**	n.d.	n.d.	n.d.	n.d.
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#118 [CL5]	**0.34**	**0.11**	n.d.	**0.21**	**0.22**
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**0.65**	n.d.	n.d.	n.d.	n.d.
#105 [CL5]	**0.22**	n.d.	n.d.	n.d.	n.d.
#138/#158 [CL6]	**0.37**	n.d.	n.d.	n.d.	n.d.

Cont. table A.1.2

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	**Sample ID:**				
	Storvatnet (232), Nordland, Norway (0-1)	Skovatn (235), Troms, Norway (0-1)	Kapervatn (236), Troms, Norway (0-1)	Storvatn (242), Troms, Norway (0-1)	Peder Sorensens vatn (245), Troms, Norway (0-1)
Lab Code:	PAS 06	PAS 07	PAS 08	PAS 09	PAS 10
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#128 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#167 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#171 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#156 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#180 [CL7]	**0.10**	n.d.	n.d.	n.d.	n.d.
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PCB`s	**3.54**	**2.15**	**0.55**	**1.51**	**1.43**
	Surrogate Internal Standards, % Recovery				
#28 [CL3] C^{13}	*107*	*76*	*75*	*95*	*77*
#52 [CL4] C^{13}	*82*	*65*	*68*	*67*	*76*
#101 [CL5] C^{13}	*84*	*63*	*86*	*71*	*75*
#153 [CL6] C^{13}	*83*	*70*	*115*	*73*	*70*
#138 [CL6] C^{13}	*75*	*70*	*120*	*72*	*65*
#180 [CL7] C^{13}	*98*	*86*	*166*	*90*	*101*
#209 [CL10] C^{13}	*131*	*111*	*100*	*92*	*100*
Weight, g	2.12	2.09	2.02	2.03	2.02

Table A.1.3

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	**Sample ID:**					
	Langfjord vatn (248), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1) D	Langvatn (257), Finnmark, Norway (0-1)		
Lab Code:	PAS 11	PAS 12	PAS 12 D	PAS 13		
#1 [CL1]	n.d.	n.d.	n.d.	n.d.		
#3 [CL1]	n.d.	n.d.	n.d.	n.d.		
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.		
#8 [CL2]	n.d.	n.d.	n.d.	n.d.		
#19 [CL3]	n.d.	n.d.	n.d.	n.d.		
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.		
#28/#31 [CL3]	**0.38**	**0.19**	**0.16**	**0.09**		
#54 [CL4]	n.d.	n.d.	n.d.	n.d.		
#33 [CL3]	n.d.	n.d.	n.d.	n.d.		
#22 [CL3]	n.d.	n.d.	n.d.	n.d.		
#52 [CL4]	**0.12**	n.d.	n.d.	n.d.		
#49 [CL4]	n.d.	n.d.	n.d.	n.d.		
#104 [CL5]	n.d.	n.d.	n.d.	n.d.		
#44 [CL4]	n.d.	n.d.	n.d.	n.d.		
#37 [CL3]	n.d.	n.d.	n.d.	n.d.		
#74 [CL4]	n.d.	**0.33**	**0.26**	**0.54**		
#70 [CL4]	**0.31**	**0.42**	**0.33**	**0.63**		
#95 [CL5]	n.d.	**0.40**	**0.31**	**0.56**		
#155 [CL6]	n.d.	n.d.	n.d.	n.d.		
#101 [CL5]	**0.53**	**0.44**	**0.35**	**0.42**		
#99 [CL5]	**0.22**	**0.10**	**0.12**	**0.08**		
#119 [CL5]	n.d.	n.d.	n.d.	n.d.		
#87 [CL5]	n.d.	n.d.	n.d.	n.d.		
#110 [CL5]	**0.48**	**0.47**	**0.37**	**0.61**		
#151 [CL6]	n.d.	n.d.	n.d.	**0.19**		
#149 [CL6]	n.d.	**0.36**	**0.46**	**0.20**		
#123 [CL5]	n.d.	n.d.	n.d.	n.d.		
#118 [CL5]	**0.27**	**0.40**	**0.51**	**0.20**		
#114 [CL5]	n.d.	n.d.	n.d.	n.d.		
#188 [CL7]	n.d.	n.d.	n.d.	n.d.		
#153/#168 [CL6]	n.d.	**0.26**	**0.21**	**0.67**		
#105 [CL5]	n.d.	**0.32**	**0.25**	**0.49**		
#138/#158 [CL6]	**0.40**	**0.27**	**0.21**	**0.64**		

Cont. table A.1.3

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:					
	Langfjord vatn (248), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1) D	Langvatn (257), Finnmark, Norway (0-1)		
Lab Code:	PAS 11	PAS 12	PAS 12 D	PAS 13		
#178 [CL7]	n.d.	n.d.	n.d.	n.d.		
#187 [CL7]	n.d.	n.d.	n.d.	n.d.		
#183 [CL7]	n.d.	n.d.	n.d.	n.d.		
#128 [CL6]	n.d.	**0.12**	**0.10**	**0.17**		
#167 [CL6]	n.d.	n.d.	n.d.	n.d.		
#177 [CL7]	n.d.	n.d.	n.d.	**0.11**		
#202 [CL8]	n.d.	n.d.	n.d.	n.d.		
#171 [CL7]	n.d.	n.d.	n.d.	**0.06**		
#156 [CL6]	n.d.	n.d.	n.d.	**0.18**		
#201 [CL8]	n.d.	n.d.	n.d.	n.d.		
#157 [CL5]	n.d.	n.d.	n.d.	n.d.		
#180 [CL7]	n.d.	n.d.	n.d.	**0.26**		
#191 [CL7]	n.d.	n.d.	n.d.	n.d.		
#170 [CL7]	n.d.	n.d.	n.d.	**0.15**		
#199 [CL8]	n.d.	n.d.	n.d.	n.d.		
#189 [CL7]	n.d.	n.d.	n.d.	n.d.		
#208 [CL9]	n.d.	n.d.	n.d.	n.d.		
#194 [CL8]	n.d.	n.d.	n.d.	**0.44**		
#205 [CL9]	n.d.	n.d.	n.d.	n.d.		
#206 [CL9]	n.d.	n.d.	n.d.	n.d.		
#209 [CL10]	n.d.	n.d.	n.d.	**0.23**		
Sum of PCB`s	**2.71**	**4.08**	**3.64**	**6.92**		
Surrogate Internal Standards, % Recovery						
#28 [CL3] C^{13}	*66*	*72*	*74*	*75*		
#52 [CL4] C^{13}	*60*	*77*	*85*	*86*		
#101 [CL5] C^{13}	*67*	*84*	*77*	*86*		
#153 [CL6] C^{13}	*65*	*73*	*74*	*65*		
#138 [CL6] C^{13}	*68*	*70*	*85*	*74*		
#180 [CL7] C^{13}	*83*	*85*	*74*	*72*		
#209 [CL10] C^{13}	*91*	*85*	*84*	*88*		
Weight, g	2.05	2.10	2.00	1.93		

35

Table A.1.4

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Langvatn (258), Finnmark, Norway (0-1)	Gukkesjavri (259), Fiinnmark, Norway (0-1)	Dabmutjavri (260), Finnmark, Norway (0-1)	Bakketekjavri (261), Finnmark, Norway (0-1)	
Lab Code:	PAS 18	PAS 19	PAS 20	PAS 21	
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	
#28/#31 [CL3]	**1.17**	**0.26**	**0.36**	n.d.	
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	
#33 [CL3]	n.d.	n.d.	n.d.	**0.09**	
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	
#52 [CL4]	n.d.	n.d.	n.d.	n.d.	
#49 [CL4]	n.d.	n.d.	n.d.	n.d.	
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	
#44 [CL4]	n.d.	n.d.	n.d.	n.d.	
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	
#74 [CL4]	**2.74**	**0.5**	**0.27**	**0.12**	
#70 [CL4]	**3.31**	**0.77**	**0.26**	**0.29**	
#95 [CL5]	**2.21**	**0.39**	**0.28**	**0.36**	
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	
#101 [CL5]	**2.62**	**0.71**	**0.45**	**0.21**	
#99 [CL5]	**0.64**	**0.19**	**0.01**	n.d.	
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	
#87 [CL5]	n.d.	n.d.	n.d.	n.d.	
#110 [CL5]	**4.19**	**1.11**	**0.75**	**0.34**	
#151 [CL6]	**0.44**	**0.12**	**0.14**	**0.09**	
#149 [CL6]	**4.90**	**0.96**	**0.10**	**0.12**	
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	
#118 [CL5]	**4.90**	**0.96**	**0.10**	**0.12**	
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	
#153/#168 [CL6]	**1.42**	**0.19**	**0.32**	**0.21**	
#105 [CL5]	**1.32**	**0.31**	**0.51**	**0.21**	
#138/#158 [CL6]	**2.48**	**0.43**	**0.50**	**0.44**	

36

Cont. table A.1.4

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID: Langvatn (258), Finnmark, Norway (0-1)	Gukkesjavri (259), Fiinnmark, Norway (0-1)	Dabmutjavri (260), Finnmark, Norway (0-1)	Bakketekjavri (261), Finnmark, Norway (0-1)	
Lab Code:	PAS 18	PAS 19	PAS 20	PAS 21	
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	
#187 [CL7]	n.d.	n.d.	n.d.	n.d.	
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	
#128 [CL6]	**0.82**	**0.11**	**0.23**	**0.16**	
#167 [CL6]	**0.21**	n.d.	**0.06**	n.d.	
#177 [CL7]	n.d.	**0.18**	n.d.	n.d.	
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	
#171 [CL7]	**0.17**	n.d.	n.d.	n.d.	
#156 [CL6]	**0.51**	n.d.	**0.11**	**0.05**	
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	
#180 [CL7]	**0.55**	n.d.	**0.07**	**0.15**	
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	
#170 [CL7]	**0.41**	**0.09**	**0.08**	n.d.	
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	
Sum of PCB`s	**35.0**	**7.28**	**4.60**	**2.96**	
#28 [CL3] C^{13}	*72*	*72*	*76*	*85*	
#52 [CL4] C^{13}	*85*	*84*	*65*	*74*	
#101 [CL5] C^{13}	*84*	*85*	*64*	*76*	
#153 [CL6] C^{13}	*76*	*86*	*69*	*89*	
#138 [CL6] C^{13}	*79*	*82*	*85*	*80*	
#180 [CL7] C^{13}	*80*	*81*	*69*	*84*	
#209 [CL10] C^{13}	*74*	*80*	*76*	*85*	
Weight, g	0.73	2.00	1.96	2.06	

37

Table A.1.5

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID: Russevikvatn (269), Finnmark, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Lavvujavri (279), Finnmark, Norway (0-1)	Avzejavri (280) Finnmark, Norway (0-1)	Gavdnajavri (282), Finnmark, Norway (0-1)
Lab Code:	PAS 26	PAS 27	PAS 28	PAS 29	PAS 30
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#28/#31 [CL3]	n.d.	**0.08**	n.d.	n.d.	n.d.
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	**0.19**	**0.04**	**0.35**	**0.27**	**0.09**
#49 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	**0.11**	n.d.	n.d.	**0.04**	n.d.
#70 [CL4]	**0.30**	n.d.	n.d.	**0.12**	n.d.
#95 [CL5]	**0.17**	n.d.	n.d.	n.d.	n.d.
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**0.25**	**0.27**	**0.38**	**0.33**	**0.33**
#99 [CL5]	**0.19**	**0.21**	**0.15**	**0.07**	**0.20**
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#110 [CL5]	**0.13**	**0.17**	**0.33**	**0.08**	**0.24**
#151 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#149 [CL6]	**0.22**	**0.18**	**0.34**	n.d.	**0.21**
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#118 [CL5]	**0.32**	**0.30**	**0.35**	**0.24**	**0.37**
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**0.12**	**0.17**	**0.57**	**0.20**	**0.28**
#105 [CL5]	**0.09**	**0.07**	**0.43**	**0.04**	**0.13**
#138/#158 [CL6]	**0.32**	**0.23**	**0.24**	**0.30**	**0.31**

38

Cont.table A.1.5

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID: Russevikvatn (269), Finnmark, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Lavvujavri (279), Finnmark, Norway (0-1)	Avzejavri (280), Finnmark, Norway (0-1)	Gavdnajavri (282), Finnmark, Norway (0-1)
Lab Code:	PAS 26	PAS 27	PAS 28	PAS 29	PAS 30
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	n.d.	n.d.	n.d.	n.d.	**0.64**
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	**0.07**
#128 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#167 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#171 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#156 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#180 [CL7]	**0.09**	n.d.	**0.81**	**0.11**	**0.16**
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PCB`s	**2.50**	**1.72**	**3.95**	**1.80**	**3.03**
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	*95*	*90*	*75*	*107*	*116*
#52 [CL4] C^{13}	*81*	*68*	*70*	*91*	*90*
#101 [CL5] C^{13}	*84*	*71*	*71*	*87*	*91*
#153 [CL6] C^{13}	*90*	*73*	*76*	*88*	*84*
#138 [CL6] C^{13}	*82*	*72*	*82*	*84*	*81*
#180 [CL7] C^{13}	*106*	*87*	*109*	*102*	*89*
#209 [CL10] C^{13}	*75*	*70*	*73*	*109*	*99*
Weight, g	2.11	2.28	2.09	2.06	2.14

39

Table A.1.6

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID: Ravdojavri (283), Finnmark, Norway (0-1)	Vuoddajavri (284), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Ratjern (291), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 31	PAS 32	PAS 33	PAS 34	PAS 35	PAS 35 D
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#28/#31 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	**0.12**	**0.18**	n.d.	**0.33**	n.d.	n.d.
#49 [CL4]	**0.05**	**0.09**	n.d.	n.d.	n.d.	n.d.
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	n.d.	**0.11**	n.d.	n.d.	n.d.	n.d.
#70 [CL4]	**0.13**	**0.22**	n.d.	n.d.	n.d.	n.d.
#95 [CL5]	**0.13**	**0.16**	n.d.	n.d.	n.d.	n.d.
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**0.22**	**0.27**	**0.30**	**0.21**	n.d.	n.d.
#99 [CL5]	**0.13**	**0.16**	n.d.	n.d.	n.d.	n.d.
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#110 [CL5]	**0.07**	**0.06**	**0.04**	**0.54**	n.d.	n.d.
#151 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#149 [CL6]	**0.12**	**0.19**	n.d.	n.d.	n.d.	n.d.
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#118 [CL5]	**0.17**	**0.31**	**0.23**	**0.47**	**1.13**	**0.98**
#114 [CL5]	**0.04**	n.d.	n.d.	n.d.	n.d.	n.d.
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**0.13**	**0.07**	**0.24**	n.d.	n.d.	n.d.
#105 [CL5]	n.d.	**0.10**	**0.04**	n.d.	n.d.	n.d.
#138/#158 [CL6]	**0.22**	**0.17**	**0.28**	n.d.	n.d.	n.d.

40

Cont. table A.1.6

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:					
	Ravdojavri (283), Finnmark, Norway (0-1)	Vuoddajavri (284), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Ratjern (291), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 31	PAS 32	PAS 33	PAS 34	PAS 35	PAS 35 D
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#128 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#167 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#171 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#156 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#180 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PCB`s	**1.53**	**2.09**	**1.13**	**1.55**	**1.13**	**0.98**
Surrogate Internal Standards, % Recovery						
#28 [CL3] C^{13}	*101*	*110*	*114*	*70*	*88*	*72*
#52 [CL4] C^{13}	*87*	*86*	*86*	*74*	*79*	*84*
#101 [CL5] C^{13}	*94*	*87*	*89*	*76*	*71*	*86*
#153 [CL6] C^{13}	*88*	*83*	*87*	*80*	*78*	*90*
#138 [CL6] C^{13}	*90*	*91*	*93*	*80*	*83*	*85*
#180 [CL7] C^{13}	*97*	*123*	*105*	*92*	*74*	*74*
#209 [CL10] C^{13}	*95*	*88*	*61*	*119*	*97*	*85*
Weight, g	2.28	2.14	2.16	2.07	1.89	1.89

41

Table A.1.7

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Andervatn (301), Finnmark, Norway (0-1)	Lille Ropelvatn (303), Finnmark, Norway (0-1)	Langvatn (87 moh) (312), Finnmark, Norway (0-1)	Coalbmejavri (316), Finnmark, Norway (0-1)	Kjeftavatn (319), Finnmark, Norway (0-1)
Lab Code:	PAS 36	PAS 37	PAS 38	PAS 39	PAS 40
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#28/#31 [CL3]	**0.16**	n.d.	**0.08**	n.d.	**0.11**
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	**0.25**	**0.17**	**0.16**	**0.13**	**0.35**
#49 [CL4]	n.d.	**0.03**	**0.05**	n.d.	n.d.
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	n.d.	**0.05**	**0.10**	**0.08**	n.d.
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	**0.13**	**0.07**	**0.08**	**0.09**	n.d.
#70 [CL4]	**0.53**	**0.26**	**0.25**	**0.36**	n.d.
#95 [CL5]	**0.27**	**0.13**	**0.16**	**0.16**	n.d.
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**0.49**	**0.28**	**0.27**	**0.38**	**0.43**
#99 [CL5]	**0.25**	**0.17**	**0.17**	**0.22**	**0.17**
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	n.d.	**0.10**	**0.06**	**0.11**	n.d.
#110 [CL5]	**0.51**	**0.33**	**0.35**	**0.46**	**0.61**
#151 [CL6]	**0.33**	**0.04**	n.d.	n.d.	n.d.
#149 [CL6]	**0.43**	**0.11**	**0.14**	**0.23**	n.d.
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#118 [CL5]	**0.45**	**0.33**	**0.32**	**0.44**	**0.52**
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**0.35**	**0.09**	**0.10**	**0.22**	**0.56**
#105 [CL5]	**0.22**	**0.21**	**0.25**	**0.29**	**0.23**
#138/#158 [CL6]	**0.50**	**0.27**	**0.21**	**0.47**	**0.45**

42

Cont. table A.1.7

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	**Sample ID:** Andervatn (301), Finnmark, Norway (0-1)	Lille Ropelvatn (303), Finnmark, Norway (0-1)	Langvatn (87 moh) (312), Finnmark, Norway (0-1)	Coalbmejavri (316), Finnmark, Norway (0-1)	Kjeftavatn (319), Finnmark, Norway (0-1)
Lab Code:	PAS 36	PAS 37	PAS 38	PAS 39	PAS 40
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	n.d.	n.d.	n.d.	**0.12**	n.d.
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#128 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#167 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#171 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#156 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#180 [CL7]	**0.36**	**0.20**	**0.17**	**0.19**	**0.09**
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	n.d.	**0.08**	n.d.	**0.14**	n.d.
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	**0.14**	**0.15**	n.d.	n.d.
Sum of PCB`s	**5.23**	**3.06**	**3.07**	**4.09**	**3.52**
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	*80*	*95*	*94*	*106*	*68*
#52 [CL4] C^{13}	*64*	*78*	*70*	*84*	*79*
#101 [CL5] C^{13}	*65*	*87*	*82*	*89*	*75*
#153 [CL6] C^{13}	*64*	*86*	*82*	*87*	*74*
#138 [CL6] C^{13}	*63*	*89*	*78*	*86*	*70*
#180 [CL7] C^{13}	*71*	*104*	*97*	*101*	*104*
#209 [CL10] C^{13}	*70*	*116*	*99*	*124*	*112*
Weight, g	2.10	1.98	1.99	1.99	2.04

Table A.1.8

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	**Sample ID:** Hestevatn (320), Finnmark, Norway (0-1)	Langvatn (302), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard Norway (0-1)	Arressjoen (501), Svalbard, Norway (0-1)	
Lab Code:	PAS 41	PAS 42	PAS 43	PAS 44	
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	
#28/#31 [CL3]	n.d.	**0.10**	**0.29**	n.d.	
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	
#52 [CL4]	n.d.	**0.19**	**0.15**	**0.16**	
#49 [CL4]	n.d.	n.d.	**0.10**	n.d.	
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	
#44 [CL4]	n.d.	n.d.	n.d.	**0.25**	
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	
#74 [CL4]	n.d.	**0.14**	**0.75**	**0.09**	
#70 [CL4]	**0.21**	**0.36**	**1.23**	**0.48**	
#95 [CL5]	n.d.	**0.19**	n.d.	**0.23**	
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	
#101 [CL5]	n.d.	**0.39**	**0.47**	**0.46**	
#99 [CL5]	n.d.	**0.21**	**2.50**	**0.29**	
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	
#87 [CL5]	n.d.	n.d.	n.d.	**0.12**	
#110 [CL5]	**0.38**	**0.43**	**0.61**	**0.47**	
#151 [CL6]	n.d.	n.d.	n.d.	n.d.	
#149 [CL6]	n.d.	**0.16**	**0.12**	n.d.	
#123 [CL5]	n.d.	n.d.	**0.36**	n.d.	
#118 [CL5]	**0.52**	**0.30**	**4.45**	**0.47**	
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	
#153/#168 [CL6]	**0.28**	**0.20**	**9.79**	**0.39**	
#105 [CL5]	**0.34**	**0.20**	**1.60**	**0.34**	
#138/#158 [CL6]	n.d.	**0.20**	**5.78**	**0.30**	

Cont. table A.1.8

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Hestevatn (320), Finnmark, Norway (0-1)	Langvatn (302), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard Norway (0-1)	Arressjoen (501), Svalbard, Norway (0-1)	
Lab Code:	PAS 41	PAS 42	PAS 43	PAS 44	
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	
#187 [CL7]	n.d.	**0.16**	**0.66**	n.d.	
#183 [CL7]	n.d.	n.d.	**0.44**	n.d.	
#128 [CL6]	n.d.	n.d.	**0.86**	n.d.	
#167 [CL6]	n.d.	n.d.	**0.39**	n.d.	
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	
#171 [CL7]	n.d.	n.d.	**0.30**	n.d.	
#156 [CL6]	n.d.	**0.07**	**0.88**	n.d.	
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	
#157 [CL5]	n.d.	n.d.	**0.23**	n.d.	
#180 [CL7]	n.d.	**0.29**	**3.32**	**0.08**	
#191 [CL7]	n.d.	n.d.	**1.41**	n.d.	
#170 [CL7]	n.d.	n.d.	n.d.	n.d.	
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	
#205 [CL9]	n.d.	n.d.	**0.17**	n.d.	
#206 [CL9]	n.d.	n.d.	**0.28**	n.d.	
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	
Sum of PCB`s	**1.73**	**3.59**	**37.1**	**4.13**	
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	*66*	*104*	*99*	*86*	
#52 [CL4] C^{13}	*71*	*75*	*84*	*67*	
#101 [CL5] C^{13}	*73*	*84*	*77*	*67*	
#153 [CL6] C^{13}	*74*	*86*	*79*	*69*	
#138 [CL6] C^{13}	*73*	*83*	*76*	*67*	
#180 [CL7] C^{13}	*97*	*100*	*89*	*80*	
#209 [CL10] C^{13}	*122*	*112*	*87*	*89*	
Weight, g	2.10	2.10	2.25	1.57	

Table A.1.9

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Kongressvatn (503), Svalbard, Norway (0-1)	Richardvatn (505), Svalbard, Norway (0-1)	Asovatn (506), Svalbard, Norway (0-1)	Trolltindvatn (325), Nordland, Norway (0-1)	
Lab Code:	PAS 46	PAS 47	PAS 50	PAS 55	
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	
#28/#31 [CL3]	n.d.	n.d.	**0.82**	n.d.	
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	
#52 [CL4]	n.d.	n.d.	n.d.	n.d.	
#49 [CL4]	n.d.	n.d.	n.d.	n.d.	
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	
#44 [CL4]	n.d.	n.d.	n.d.	n.d.	
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	
#74 [CL4]	n.d.	n.d.	n.d.	n.d.	
#70 [CL4]	**1.60**	n.d.	**1.27**	**0.36**	
#95 [CL5]	n.d.	n.d.	**0.61**	**0.26**	
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	
#101 [CL5]	**2.63**	**0.82**	**1.18**	**0.62**	
#99 [CL5]	**1.96**	n.d.	**0.63**	**0.31**	
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	
#87 [CL5]	**3.09**	n.d.	n.d.	n.d.	
#110 [CL5]	**4.20**	**0.96**	**1.77**	**0.61**	
#151 [CL6]	**0.89**	n.d.	**0.25**	n.d.	
#149 [CL6]	**4.09**	**0.50**	**0.85**	**0.46**	
#123 [CL5]	n.d.	n.d.	n.d.	n.d.	
#118 [CL5]	**4.09**	**0.50**	**0.85**	**0.46**	
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	
#153/#168 [CL6]	**3.39**	**0.58**	**1.37**	**0.33**	
#105 [CL5]	**4.30**	**0.71**	**1.18**	**0.46**	
#138/#158 [CL6]	**4.83**	**1.00**	**1.42**	**0.38**	

Cont. table A.1.9

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:				
	Kongressvatn (503), Svalbard, Norway (0-1)	Richardvatn (505), Svalbard, Norway (0-1)	Asovatn (506), Svalbard, Norway (0-1)	Trolltindvatn (325), Nordland, Norway (0-1)	
Lab Code:	PAS 46	PAS 47	PAS 50	PAS 55	
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	
#187 [CL7]	n.d.	n.d.	n.d.	n.d.	
#183 [CL7]	n.d.	n.d.	n.d.	n.d.	
#128 [CL6]	**1.99**	n.d.	n.d.	n.d.	
#167 [CL6]	**0.50**	n.d.	n.d.	n.d.	
#177 [CL7]	n.d.	n.d.	n.d.	n.d.	
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	
#171 [CL7]	**0.32**	n.d.	**0.11**	**0.05**	
#156 [CL6]	**0.95**	n.d.	**0.33**	**0.15**	
#201 [CL8]	**0.39**	n.d.	n.d.	**0.20**	
#157 [CL5]	n.d.	n.d.	n.d.	n.d.	
#180 [CL7]	**0.85**	n.d.	**0.38**	**0.14**	
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	
#170 [CL7]	**0.57**	n.d.	n.d.	n.d.	
#199 [CL8]	n.d.	n.d.	n.d.	n.d.	
#189 [CL7]	n.d.	n.d.	n.d.	n.d.	
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	
#194 [CL8]	n.d.	n.d.	n.d.	n.d.	
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	
Sum of PCB`s	**40.6**	**5.06**	**13.0**	**4.79**	
#28 [CL3] C^{13}	*85*	*85*	*79*	*96*	
#52 [CL4] C^{13}	*84*	*74*	*96*	*95*	
#101 [CL5] C^{13}	*87*	*89*	*84*	*96*	
#153 [CL6] C^{13}	*80*	*86*	*74*	*94*	
#138 [CL6] C^{13}	*85*	*89*	*90*	*96*	
#180 [CL7] C^{13}	*90*	*85*	*88*	*80*	
#209 [CL10] C^{13}	*100*	*96*	*86*	*74*	
Weight, g	2.32	1.35	0.87	2.16	

Table A.1.10

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:			
	649/1 Holmevatn (323), Troms, Norway (0-1)	Folvatn (298), Finnmark, Norway		
Lab Code:	PAS 56	PAS 58		
#1 [CL1]	n.d.	n.d.		
#3 [CL1]	n.d.	n.d.		
#4/#10 [CL2]	n.d.	n.d.		
#8 [CL2]	n.d.	n.d.		
#19 [CL3]	n.d.	n.d.		
#17/#18 [CL3]	n.d.	n.d.		
#28/#31 [CL3]	n.d.	**0.17**		
#54 [CL4]	n.d.	n.d.		
#33 [CL3]	n.d.	n.d.		
#22 [CL3]	n.d.	n.d.		
#52 [CL4]	**0.15**	n.d.		
#49 [CL4]	**3.69**	n.d.		
#104 [CL5]	n.d.	n.d.		
#44 [CL4]	n.d.	n.d.		
#37 [CL3]	n.d.	n.d.		
#74 [CL4]	n.d.	n.d.		
#70 [CL4]	n.d.	**0.35**		
#95 [CL5]	**0.15**	**0.22**		
#155 [CL6]	n.d.	n.d.		
#101 [CL5]	**0.31**	**0.52**		
#99 [CL5]	**0.22**	**0.17**		
#119 [CL5]	n.d.	n.d.		
#87 [CL5]	n.d.	n.d.		
#110 [CL5]	**0.14**	**0.67**		
#151 [CL6]	n.d.	**0.22**		
#149 [CL6]	n.d.	**0.76**		
#123 [CL5]	n.d.	n.d.		
#118 [CL5]	**0.29**	**0.76**		
#114 [CL5]	n.d.	n.d.		
#188 [CL7]	n.d.	n.d.		
#153/#168 [CL6]	**0.29**	**0.49**		
#105 [CL5]	n.d.	**0.43**		
#138/#158 [CL6]	**0.27**	**0.46**		

Cont. table A.1.10

Content of congeners of PCB in sediment, ng/g dry weight

Congener PCB (IUPAC)	Sample ID:			
	649/1 Holmevatn (323), Troms, Norway (0-1)	Folvatn (298), Finnmark, Norway		
Lab Code:	PAS 56	PAS 58		
#178 [CL7]	n.d.	n.d.		
#187 [CL7]	n.d.	n.d.		
#183 [CL7]	n.d.	n.d.		
#128 [CL6]	n.d.	n.d.		
#167 [CL6]	n.d.	n.d.		
#177 [CL7]	n.d.	**0.09**		
#202 [CL8]	n.d.	n.d.		
#171 [CL7]	n.d.	n.d.		
#156 [CL6]	n.d.	**0.08**		
#201 [CL8]	n.d.	**0.49**		
#157 [CL5]	n.d.	n.d.		
#180 [CL7]	**0.15**	**0.10**		
#191 [CL7]	n.d.	n.d.		
#170 [CL7]	n.d.	**0.12**		
#199 [CL8]	n.d.	n.d.		
#189 [CL7]	n.d.	n.d.		
#208 [CL9]	n.d.	n.d.		
#194 [CL8]	n.d.	n.d.		
#205 [CL9]	n.d.	n.d.		
#206 [CL9]	n.d.	n.d.		
#209 [CL10]	n.d.	n.d.		
Sum of PCB`s	**5.66**	**6.11**		
Surrogate Internal Standards, % Recovery				
#28 [CL3] C^{13}	*98*	*88*		
#52 [CL4] C^{13}	*81*	*84*		
#101 [CL5] C^{13}	*83*	*85*		
#153 [CL6] C^{13}	*85*	*79*		
#138 [CL6] C^{13}	*83*	*86*		
#180 [CL7] C^{13}	*105*	*96*		
#209 [CL10] C^{13}	*124*	*82*		
Weight, g	2.02	2.17		

Table A.2.1

Content of congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen	Richardvatn (505), Svalbard, Norway, Fish Richardvatn
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04	PAB 05
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	**0.10**	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	**0.13**	n.d.	n.d.
#28/#31 [CL3]	n.d.	n.d.	**0.39**	**0.31**	n.d.
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	**0.28**	**0.34**	**0.39**	n.d.	**0.41**
#49 [CL4]	n.d.	**0.27**	**0.67**	n.d.	**0.13**
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	**0.13**	**0.30**	**0.19**	n.d.	**0.22**
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	**0.18**	n.d.	**2.07**	**0.58**	**0.22**
#70 [CL4]	**0.36**	**0.91**	**3.19**	**1.84**	**0.48**
#95 [CL5]	**0.24**	n.d.	**0.41**	n.d.	**0.53**
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**0.50**	**0.36**	**1.47**	**0.83**	**1.24**
#99 [CL5]	**0.36**	**0.29**	**1.03**	**2.08**	**1.18**
#119 [CL5]	n.d.	n.d.	**0.31**	n.d.	n.d.
#87 [CL5]	**0.20**	n.d.	**0.35**	n.d.	**0.34**
#110 [CL5]	**0.39**	n.d.	**2.16**	**0.56**	**0.89**
#151 [CL6]	**0.13**	n.d.	n.d.	n.d.	**0.91**
#149 [CL6]	**0.52**	**0.31**	**0.70**	**0.61**	**1.67**
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**1.62**	**0.97**	**63.0**	**12.8**	**8.58**
#138/#158 [CL6]	**0.79**	**0.65**	**28.8**	**7.21**	**3.96**
#178 [CL7]	n.d.	n.d.	**0.19**	n.d.	**0.32**
#187 [CL7]	**0.44**	n.d.	**4.87**	**1.07**	**1.76**
#183 [CL7]	n.d.	n.d.	**2.96**	**0.73**	**0.44**
#128 [CL6]	n.d.	n.d.	**3.07**	**1.09**	**0.99**

Cont. table A.2.1

Content congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen	Richardvatn (505), Svalbard, Norway, Fish Richardvatn
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04	PAB 05
#177 [CL7]	n.d.	n.d.	**0.48**	n.d.	**0.38**
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	**0.15**
#171 [CL7]	n.d.	n.d.	**0.75**	n.d.	n.d.
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#191 [CL7]	n.d.	n.d.	**0.31**	n.d.	n.d.
#199 [CL8]	n.d.	n.d.	**0.60**	n.d.	**0.41**
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	n.d.	n.d.	**1.05**	n.d.	n.d.
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	n.d.	**0.15**	n.d.	n.d.
Sum of PCB`s	**6.14**	**4.40**	**119.7**	**29.8**	**25.2**
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	*94*	*78*	*101*	*64*	*119*
#52 [CL4] C^{13}	*78*	*73*	*83*	*70*	*92*
#101 [CL5] C^{13}	*79*	*69*	*87*	*64*	*92*
#153 [CL6] C^{13}	*78*	*72*	*93*	*72*	*90*
#138 [CL6] C^{13}	*77*	*80*	*91*	*77*	*88*
#180 [CL7] C^{13}	*85*	*116*	*100*	*102*	*105*
#209 [CL10] C^{13}	*92*	*169*	*110*	*121*	*113*
Weight, g	2.18	2.14	2.10	2.12	2.18
Lipid, %	3.51	1.53	1.70	3.47	1.76

51

Table A.2.2

Content of congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D	Richardvatn (505), Svalbard, Norway, R1
Lab Code:	PAB 06	PAB 07	PAB 08	PAB 08 D	PAB 09
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	n.d.	**0.20**
#28/#31 [CL3]	**0.34**	**0.08**	n.d.	n.d.	**1.03**
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	**0.13**	n.d.	n.d.	n.d.	**0.11**
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	**0.14**
#52 [CL4]	**0.53**	**0.31**	**0.18**	**0.15**	**0.34**
#49 [CL4]	**0.73**	**0.19**	n.d.	n.d.	**0.45**
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	**0.24**	**0.19**	n.d.	n.d.	**0.24**
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	**0.27**
#74 [CL4]	**1.40**	**0.17**	n.d.	n.d.	**0.33**
#70 [CL4]	**2.87**	**0.55**	n.d.	n.d.	**0.45**
#95 [CL5]	**0.89**	**0.25**	n.d.	n.d.	**0.40**
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	**1.78**	**0.44**	**0.28**	**0.29**	**1.22**
#99 [CL5]	**9.11**	**0.44**	**0.28**	**0.24**	**1.26**
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	**0.55**	n.d.	n.d.	n.d.	**0.27**
#110 [CL5]	**1.94**	**0.45**	**0.38**	**0.41**	**0.84**
#151 [CL6]	**0.65**	**0.29**	n.d.	n.d.	**0.74**
#149 [CL6]	**2.07**	**0.56**	n.d.	n.d.	**1.45**
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	**46.5**	**1.61**	**0.39**	**0.50**	**8.39**
#138/#158 [CL6]	**22.9**	**0.74**	**0.34**	**0.36**	**3.02**
#178 [CL7]	n.d.	n.d.	n.d.	n.d.	**0.28**
#187 [CL7]	**4.85**	**0.28**	n.d.	n.d.	**1.59**
#183 [CL7]	**2.77**	n.d.	n.d.	n.d.	**0.31**

52

Cont. table A.2.2

Content congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D	Richardvatn (505), Svalbard, Norway, R1
Lab Code:	PAB 06	PAB 07	PAB 08	PAB 08 D	PAB 09
#128 [CL6]	3.09	n.d.	n.d.	n.d.	1.04
#177 [CL7]	0.67	n.d.	n.d.	n.d.	0.38
#202 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#171 [CL7]	0.69	n.d.	n.d.	n.d.	0.44
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	n.d.
#191 [CL7]	0.53	n.d.	n.d.	n.d.	n.d.
#199 [CL8]	0.96	n.d.	n.d.	n.d.	0.32
#208 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#194 [CL8]	1.06	n.d.	n.d.	n.d.	0.35
#205 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	0.62
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PCB`s	107.3	6.55	1.85	1.95	26.5
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	66	75	74	78	88
#52 [CL4] C^{13}	62	71	69	79	69
#101 [CL5] C^{13}	56	68	77	69	74
#153 [CL6] C^{13}	73	81	74	78	80
#138 [CL6] C^{13}	72	79	74	72	78
#180 [CL7] C^{13}	93	109	98	95	96
#209 [CL10] C^{13}	124	115	125	119	79
Weight, g	2.13	2.18	2.16	2.22	2.66
Lipid, %	2.97	2.38	0.20	0.15	0.41

53

Table A.2.3

Content of congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Richardvatn (505), Svalbard, Norway, R2	Richardvatn (505), Svalbard, Norway, R4	Richardvatn (505), Svalbard, Norway, R5	Richardvatn (505), Svalbard, Norway, R6	Asovatn (506), Svalbard, Norway, A9
Lab Code:	PAB 10	PAB 11	PAB 12	PAB 13	PAB 14
#1 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	0.14	n.d.	n.d.	n.d.
#28/#31 [CL3]	0.26	0.15	0.42	0.35	0.74
#54 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	0.26	0.13	0.81	0.70	1.52
#49 [CL4]	0.13	n.d.	0.64	0.45	2.46
#104 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	0.26	0.50	0.36	0.30	0.55
#37 [CL3]	n.d.	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	0.17	n.d.	0.49	0.44	4.75
#70 [CL4]	0.59	0.43	0.89	1.98	9.01
#95 [CL5]	0.25	0.22	1.35	1.33	2.72
#155 [CL6]	n.d.	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	0.82	1.10	3.05	3.53	6.43
#99 [CL5]	0.68	1.33	3.01	3.46	32.3
#119 [CL5]	n.d.	n.d.	n.d.	n.d.	0.95
#81 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	n.d.	0.13	0.78	0.78	1.66
#110 [CL5]	0.62	0.59	2.31	2.57	6.25
#77 [CL4]	n.d.	n.d.	n.d.	n.d.	n.d.
#151 [CL6]	0.44	1.14	2.07	1.92	2.19
#149 [CL6]	0.95	1.68	4.08	4.12	6.03
#123 [CL5]	0.50	0.43	0.8	0.79	5.41
#118 [CL5]	0.96	2.39	4.37	5.96	61.2
#114 [CL5]	n.d.	n.d.	n.d.	n.d.	1.43
#188 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	3.54	17.9	21.1	22.8	179
#105 [CL5]	0.30	0.39	1.14	1.93	18.7
#138/#158 [CL6]	1.29	6.37	11.0	11.9	96.6

54

Cont. table A.2.3

Content congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Richardvatn (505), Svalbard, Norway, R2	Richardvatn (505), Svalbard, Norway, R4	Richardvatn (505), Svalbard, Norway, R5	Richardvatn (505), Svalbard, Norway, R6	Asovatn (506), Svalbard, Norway, A9
Lab Code:	PAB 10	PAB 11	PAB 12	PAB 13	PAB 14
#178 [CL7]	0.10	0.66	0.76	0.80	0.89
#126 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	0.73	3.88	3.82	4.82	14.7
#183 [CL7]	0.13	0.79	0.71	115	8.4
#128 [CL6]	0.59	1.64	2.56	2.85	9.47
#167 [CL6]	n.d.	0.56	0.52	0.59	5.63
#177 [CL7]	0.29	1.00	1.15	1.47	1.83
#202 [CL8]	n.d.	0.19	0.19	0.19	n.d.
#171 [CL7]	n.d.	0.29	0.36	0.39	1.88
#156 [CL6]	0.22	0.89	1.02	1.40	12.5
#201 [CL8]	n.d.	n.d.	n.d.	n.d.	0.31
#157 [CL5]	n.d.	0.24	0.34	0.82	4.18
#180 [CL7]	0.66	5.13	4.64	6.18	42.7
#191 [CL7]	n.d.	n.d.	n.d.	n.d.	n.d.
#169 [CL5]	n.d.	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	0.41	3.16	2.65	3.48	19.4
#199 [CL8]	n.d.	0.83	0.85	1.33	3.16
#189 [CL7]	n.d.	0.15	n.d.	n.d.	1.01
#208 [CL9]	n.d.	0.39	1.08	0.92	0.46
#194 [CL8]	n.d.	1.05	n.d.	1.23	5.79
#205 [CL9]	n.d.	n.d.	4.14	n.d.	0.54
#206 [CL9]	n.d.	n.d.	n.d.	n.d.	n.d.
#209 [CL10]	n.d.	n.d.	n.d.	n.d.	1.82
Sum of PCB`s	15.2	55.9	83.5	206.8	574.6
Surrogate Internal Standards, % Recovery					
#28 [CL3] C^{13}	*75*	*104*	*77*	*72*	*71*
#52 [CL4] C^{13}	*72*	*81*	*79*	*77*	*77*
#101 [CL5] C^{13}	*64*	*79*	*62*	*78*	*60*
#153 [CL6] C^{13}	*72*	*86*	*75*	*79*	*82*
#138 [CL6] C^{13}	*75*	*82*	*75*	*84*	*86*
#180 [CL7] C^{13}	*108*	*102*	*96*	*99*	*109*
#209 [CL10] C^{13}	*75*	*76*	*77*	*74*	*79*
Weight, g	2.92	2.89	3.00	2.91	2.95
Lipid, %	1.45	0.76	7.24	4.18	9.50

55

Table A.2.4

Content of congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:			
	Asovatn (506), Svalbard, Norway, A10	Asovatn (506), Svalbard, Norway, A11	Asovatn (506), Svalbard, Norway, A12	Asovatn (506), Svalbard, Norway, A13
Lab Code:	PAB 15	PAB 16	PAB 17	PAB 18
#1 [CL1]	n.d.	n.d.	n.d.	n.d.
#3 [CL1]	n.d.	n.d.	n.d.	n.d.
#4/#10 [CL2]	n.d.	n.d.	n.d.	n.d.
#8 [CL2]	n.d.	n.d.	n.d.	n.d.
#19 [CL3]	n.d.	n.d.	n.d.	n.d.
#17/#18 [CL3]	n.d.	n.d.	n.d.	0.13
#28/#31 [CL3]	0.86	0.24	0.44	0.29
#54 [CL4]	n.d.	n.d.	n.d.	n.d.
#33 [CL3]	n.d.	n.d.	n.d.	n.d.
#22 [CL3]	n.d.	n.d.	n.d.	n.d.
#52 [CL4]	0.96	0.56	0.61	0.38
#49 [CL4]	2.02	1.07	1.11	0.56
#104 [CL5]	n.d.	n.d.	n.d.	n.d.
#44 [CL4]	0.47	0.24	0.26	0.18
#37 [CL3]	n.d.	n.d.	n.d.	n.d.
#74 [CL4]	3.29	1.81	2.10	1.26
#70 [CL4]	6.27	3.21	4.26	2.44
#95 [CL5]	2.47	1.38	1.34	0.9
#155 [CL6]	n.d.	n.d.	n.d.	n.d.
#101 [CL5]	5.05	3.23	3.01	1.93
#99 [CL5]	26.4	18.1	17.9	10.6
#119 [CL5]	0.54	0.44	n.d.	0.26
#81 [CL4]	n.d.	n.d.	n.d.	n.d.
#87 [CL5]	1.13	0.67	0.77	0.44
#110 [CL5]	4.59	3.02	3.29	1.68
#77 [CL4]	n.d.	n.d.	n.d.	n.d.
#151 [CL6]	1.51	1.16	1.02	0.64
#149 [CL6]	4.35	3.58	2.83	1.99
#123 [CL5]	3.51	2.24	2.49	1.61
#118 [CL5]	45.7	31.4	30.2	18.9
#114 [CL5]	0.98	0.54	0.71	0.36
#188 [CL7]	n.d.	n.d.	n.d.	n.d.
#153/#168 [CL6]	128.0	103.0	88.2	53.9
#105 [CL5]	12.70	9.13	0.51	5.17
#138/#158 [CL6]	53.0	44.0	39.6	25.1

56

Cont. table A.2.4

Content congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID: Asovatn (506), Svalbard, Norway, A10	Asovatn (506), Svalbard, Norway, A11	Asovatn (506), Svalbard, Norway, A12	Asovatn (506), Svalbard, Norway, A13
Lab Code:	PAB 15	PAB 16	PAB 17	PAB 18
#178 [CL7]	**0.60**	**0.54**	**0.42**	**0.25**
#126 [CL5]	n.d.	n.d.	n.d.	n.d.
#187 [CL7]	**12.4**	**10.1**	**7.90**	**4.65**
#183 [CL7]	**6.32**	**5.17**	**4.08**	**2.19**
#128 [CL6]	**7.45**	**5.94**	**5.38**	**3.3**
#167 [CL6]	**4.09**	**2.88**	**3.36**	**1.93**
#177 [CL7]	**1.35**	**1.02**	**0.93**	**0.52**
#202 [CL8]	n.d.	n.d.	**0.16**	n.d.
#171 [CL7]	**1.51**	**1.05**	**0.95**	**0.55**
#156 [CL6]	**8.44**	**6.70**	**5.64**	**3.76**
#201 [CL8]	n.d.	**0.16**	n.d.	n.d.
#157 [CL5]	**2.38**	**1.42**	**1.80**	**0.90**
#180 [CL7]	**33.2**	**25.8**	**21.6**	**12.7**
#191 [CL7]	n.d.	n.d.	n.d.	n.d.
#169 [CL5]	n.d.	n.d.	n.d.	n.d.
#170 [CL7]	**14.2**	**11.2**	**9.20**	**5.52**
#199 [CL8]	**2.27**	**1.92**	**1.69**	**0.75**
#189 [CL7]	**0.66**	**0.47**	**0.45**	**0.26**
#208 [CL9]	n.d.	**0.30**	n.d.	**0.34**
#194 [CL8]	**3.48**	**3.06**	**2.89**	**1.22**
#205 [CL9]	n.d.	**0.69**	n.d.	n.d.
#206 [CL9]	n.d.	**0.88**	n.d.	**0.42**
#209 [CL10]	n.d.	**0.90**	n.d.	n.d.
Sum of PCB`s	**402.2**	**309.2**	**267.1**	**168.0**
Surrogate Internal Standards, % Recovery				
#28 [CL3] C^{13}	*64*	*121*	*66*	*98*
#52 [CL4] C^{13}	*60*	*88*	*67*	*80*
#101 [CL5] C^{13}	*67*	*87*	*66*	*78*
#153 [CL6] C^{13}	*85*	*92*	*90*	*89*
#138 [CL6] C^{13}	*81*	*88*	*88*	*85*
#180 [CL7] C^{13}	*101*	*108*	*121*	*107*
#209 [CL10] C^{13}	*74*	*99*	*74*	*80*
Weight, g	2.92	2.93	2.98	2.90
Lipid, %	10.03	1.21	6.41	7.45

Table A.3.1

Content of planar and mono-orthosubstituted congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID: Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04
#CL4 81	n.d.	n.d.	n.d.	n.d.
#CL4 77	n.d.	n.d.	**0.35**	n.d.
#CL5 123	**0.14**	**0.13**	**1.28**	**0.40**
#CL5 118	**0.55**	**0.45**	**13.4**	**3.08**
#CL5 114	n.d.	n.d.	**0.51**	n.d.
#CL5 105	n.d.	n.d.	**3.22**	**0.61**
#CL5 126	n.d.	n.d.	n.d.	n.d.
#CL6 167	**0.18**	n.d.	**1.28**	**0.36**
#CL6 156	n.d.	n.d.	**1.21**	**0.32**
#CL6 157	n.d.	n.d.	**0.31**	**0.32**
#CL6 169	n.d.	n.d.	n.d.	n.d.
#CL7 180	**0.57**	**0.28**	**10.4**	**2.62**
#CL7 170	**0.19**	n.d.	**2.96**	**0.95**
#CL7 189	n.d.	n.d.	n.d.	n.d.
Sum of PCB`s	**1.63**	**0.86**	**34.9**	**8.66**
Surrogate Internal Standards, % Recovery				
#CL4 81 C^{13}	*116*	*118*	*79*	*79*
#CL4 77 C^{13}	*110*	*107*	*83*	*96*
#CL5 123 C^{13}	*104*	*95*	*75*	*82*
#CL5 118 C^{13}	*98*	*95*	*72*	*77*
#CL5 114 C^{13}	*81*	*74*	*73*	*67*
#CL5 105 C^{13}	*118*	*111*	*88*	*93*
#CL5 126 C^{13}	*118*	*124*	*78*	*110*
#CL6 167 C^{13}	*117*	*110*	*79*	*98*
#CL6 156 C^{13}	*116*	*121*	*80*	*100*
#CL6 157 C^{13}	*113*	*121*	*80*	*112*
#CL6 169 C^{13}	*108*	*109*	*94*	*116*
#CL7 180 C^{13}	*102*	*107*	*84*	*104*
#CL7 170 C^{13}	*100*	*115*	*72*	*113*
#CL7 189 C^{13}	*113*	*108*	*95*	*116*
Weight, g	2.18	2.17	2.12	2.13
Lipid, %	3.51	1.53	1.70	3.47

Table A.3.2

Content of planar and mono-orthosubstituted congeners of PCB in biota, ng/g wet weight

Congener PCB (IUPAC)	Sample ID:				
	Richardvatn (505), Svalbard, Norway, Fish Richardvatn	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D
Lab Code:	PAB 05	PAB 06	PAB 07	PAB 08	PAB 08D
#CL4 81	n.d.	**0.11**	n.d.	n.d.	n.d.
#CL4 77	n.d.	**0.16**	n.d.	n.d.	n.d.
#CL5 123	**0.46**	**2.17**	**0.15**	n.d.	n.d.
#CL5 118	**1.43**	**15.3**	**0.73**	**0.46**	**0.59**
#CL5 114	n.d.	**0.51**	n.d.	n.d.	n.d.
#CL5 105	**0.32**	**1.99**	**0.23**	n.d.	n.d.
#CL5 126	n.d.	n.d.	n.d.	n.d.	n.d.
#CL6 167	**0.32**	**1.02**	n.d.	n.d.	n.d.
#CL6 156	**0.27**	**1.64**	n.d.	n.d.	n.d.
#CL6 157	n.d.	**0.30**	n.d.	n.d.	n.d.
#CL6 169	n.d.	n.d.	n.d.	n.d.	n.d.
#CL7 180	**2.10**	**10.7**	**0.69**	**0.14**	**0.15**
#CL7 170	**0.68**	**2.88**	**0.20**	n.d.	n.d.
#CL7 189	n.d.	**0.16**	n.d.	n.d.	n.d.
Sum of PCB`s	**5.58**	**36.9**	**2.00**	**0.60**	**0.74**
Surrogate Internal Standards, % Recovery					
#CL4 81 C^{13}	*108*	*120*	*111*	*125*	*119*
#CL4 77 C^{13}	*110*	*122*	*119*	*119*	*115*
#CL5 123 C^{13}	*93*	*105*	*99*	*96*	*96*
#CL5 118 C^{13}	*88*	*100*	*93*	*89*	*85*
#CL5 114 C^{13}	*75*	*87*	*75*	*79*	*77*
#CL5 105 C^{13}	*109*	*112*	*102*	*109*	*108*
#CL5 126 C^{13}	*125*	*119*	*114*	*124*	*119*
#CL6 167 C^{13}	*116*	*120*	*115*	*106*	*114*
#CL6 156 C^{13}	*117*	*111*	*122*	*125*	*103*
#CL6 157 C^{13}	*115*	*113*	*112*	*119*	*107*
#CL6 169 C^{13}	*117*	*123*	*111*	*112*	*109*
#CL7 180 C^{13}	*119*	*118*	*104*	*87*	*109*
#CL7 170 C^{13}	*115*	*128*	*119*	*122*	*117*
#CL7 189 C^{13}	*118*	*104*	*100*	*115*	*102*
Weight, g	2.20	2.19	2.18	2.16	2.22
Lipid, %	1.76	2.97	2.38	0.20	0.15

59

Table A.4.1

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Holmevatn (72), Nordland, Norway (1-0)	Valnesvatn (210), Nordland, Norway (0-1)	Vikvatn (224), Nordland, Norway (0-1)	Strumpvatn (226), Nordland (0-1)	Storvatn (227), Nordland, Norway (0-1)
Lab Code:	PAS 01	PAS 02	PAS 03	PAS 04	PAS 05
HCB	n.d.	**0.39**	n.d.	**0.26**	**0.46**
α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
β-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	**0.10**	n.d.	n.d.	n.d.
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Nonachlor	n.d.	**0.02**	n.d.	n.d.	n.d.
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Chlordanes	n.d.	**0.12**	n.d.	n.d.	n.d.
2,4`-DDE	**0.22**	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**0.38**	n.d.	**0.64**	**0.66**	**0.43**
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of DDT	**0.60**	n.d.	**0.64**	**0.66**	**0.43**
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*58*	*55*	*59*	*51*	*60*
γ-HCH C^{13}	*62*	*60*	*69*	*64*	*73*
4,4`-DDE C^{13}	*76*	*70*	*76*	*77*	*72*
4,4`-DDT C^{13}	*74*	*112*	*101*	*72*	*99*
Weight, g	1.55	2.00	2.10	2.07	2.19

60

Table A.4.2

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Storvatnet (232), Nordland, Norway (0-1)	Skovatn (235), Troms, Norway (0-1)	Kapervatn (236), Troms, Norway (0-1)	Storvatn (242), Troms, Norway (0-1)	Peder Sorensens vatn (245), Troms, Norway (0-1)
Lab Code:	PAS 06	PAS 07	PAS 08	PAS 09	PAS 10
HCB	**0.44**	**0.21**	n.d.	n.d.	n.d.
α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
β-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Chlordanes	n.d.	n.d.	n.d.	n.d.	n.d.
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**0.74**	n.d.	n.d.	n.d.	n.d.
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	**0.15**	n.d.	n.d.	n.d.	n.d.
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of DDT	**0.89**	n.d.	n.d.	n.d.	n.d.
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	**0.25**	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*58*	*51*	*61*	*69*	*52*
γ-HCH C^{13}	*59*	*68*	*63*	*63*	*62*
4,4`-DDE C^{13}	*86*	*74*	*78*	*72*	*61*
4,4`-DDT C^{13}	*108*	*116*	*80*	*67*	*94*
Weight, g	2.12	2.09	2.02	2.03	2.02

Table A.4.3

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:					
	Langfjord vatn (248), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1) D	Langvatn (257), Finnmark, Norway (0-1)	Langvatn (257), Finnmark, Norway (1-2)	Langvatn (257), Finnmark, Norway (2-3)
Lab Code:	PAS 11	PAS 12	PAS 12 D	PAS 13	PAS 14	PAS 15
HCB	**0.21**	n.d.	n.d.	**1.21**	**0.92**	**0.97**
α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
β-HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Chlordanes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**0.32**	**0.35**	**0.42**	**2.53**	**1.22**	**0.42**
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,4`-DDT	n.d.	n.d.	n.d.	**0.17**	n.d.	n.d.
4,4`-DDT	n.d.	n.d.	n.d.	**0.22**	n.d.	n.d.
Sum of DDT	**0.32**	**0.35**	**0.42**	**2.92**	**1.22**	**0.42**
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery						
HCB C^{13}	*56*	*85*	*85*	*85*	*85*	*82*
γ-HCH C^{13}	*67*	*74*	*74*	*74*	*74*	*74*
4,4`-DDE C^{13}	*69*	*76*	*79*	*79*	*76*	*75*
4,4`-DDT C^{13}	*96*	*71*	*77*	*88*	*78*	*76*
Weight, g	2.05	2.10	2.00	1.93	1.99	2.00

Table A.4.4

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Langvatn (258), Finnmark, Norway (0-1)	Gukkesjavri (259), Finnmark, Norway (0-1)	Dabmutjavri (260), Finnmark, Norway (0-1)	Bakketekjavri (261), Finnmark, Norway (0-1)	
Lab Code:	PAS 18	PAS 19	PAS 20	PAS 21	
HCB	**2.27**	n.d.	n.d.	**0.66**	
α-HCH	n.d.	n.d.	n.d.	n.d.	
β-HCH	n.d.	n.d.	n.d.	n.d.	
γ-HCH	n.d.	n.d.	n.d.	n.d.	
Sum of HCH	n.d.	n.d.	n.d.	n.d.	
Heptachlor	n.d.	n.d.	n.d.	n.d.	
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	
Oxychlordane	n.d.	n.d.	**0.09**	n.d.	
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	
Sum of Chlordanes	n.d.	n.d.	**0.09**	n.d.	
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	
4,4`-DDE	**3.43**	**0.50**	**0.58**	**1.14**	
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	
4,4`-DDT	**0.41**	n.d.	n.d.	n.d.	
Sum of DDT	**3.84**	**0.50**	**0.58**	**1.14**	
Endrin	n.d.	n.d.	n.d.	n.d.	
Dieldrin	n.d.	n.d.	n.d.	n.d.	
Mirex	n.d.	n.d.	n.d.	n.d.	
HCB C^{13}	*84*	*79*	*77*	*85*	
γ-HCH C^{13}	*79*	*85*	*88*	*75*	
4,4`-DDE C^{13}	*86*	*97*	*96*	*78*	
4,4`-DDT C^{13}	*84*	*87*	*89*	*79*	
Weight, g	0.73	2.00	1.96	2.06	

Table A.4.5

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Russevikvatn (269), Finnmark, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Lavvujavri (279), Finnmark, Norway (0-1)	Avzejavri (280), Finnmark, Norway (0-1)	Gavdnajavri (282), Finnmark, Norway (0-1)
Lab Code:	PAS 26	PAS 27	PAS 28	PAS 29	PAS 30
HCB	**0.11**	**0.12**	n.d.	**0.15**	**0.16**
α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
β-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Chlordanes	n.d.	n.d.	n.d.	n.d.	n.d.
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**0.12**	**0.22**	**0.30**	**0.20**	**0.34**
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	**0.08**
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of DDT	**0.12**	**0.22**	**0.30**	**0.20**	**0.42**
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	**0.03**	n.d.	n.d.	**0.38**
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*59*	*54*	*51*	*63*	*68*
γ-HCH C^{13}	*81*	*78*	*62*	*89*	*48*
4,4`-DDE C^{13}	*85*	*85*	*82*	*103*	*107*
4,4`-DDT C^{13}	*98*	*93*	*82*	*80*	*72*
Weight, g	2.11	2.28	2.09	2.06	2.14

Table A.4.6

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:					
	Ravdojavri (283), Finnmark, Norway (0-1)	Vuoddajavri (284), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Ratjern (291), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 31	PAS 32	PAS 33	PAS 34	PAS 35	PAS 35 D
HCB	**0.10**	**0.05**	**0.08**	**0.49**	n.d.	n.d.
α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
β-HCH	n.d.	n.d.	**0.12**	n.d.	n.d.	n.d.
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	n.d.	n.d.	**0.12**	n.d.	n.d.	n.d.
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Nonachlor	n.d.	**0.02**	n.d.	n.d.	n.d.	n.d.
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Chlordanes	n.d.	**0.02**	n.d.	n.d.	n.d.	n.d.
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**0.09**	**0.08**	**1.00**	**0.38**	n.d.	n.d.
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	n.d.	**0.07**	n.d.	n.d.	n.d.	n.d.
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of DDT	**0.09**	**0.15**	**1.00**	**0.38**	n.d.	n.d.
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	n.d.	**0.39**	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery						
HCB C^{13}	*53*	*62*	*64*	*54*	*51*	*74*
γHCH C^{13}	*82*	*125*	*80*	*75*	*60*	*75*
4,4`-DDE C^{13}	*106*	*110*	*114*	*63*	*78*	*72*
4,4`-DDT C^{13}	*94*	*122*	*101*	*76*	*80*	*80*
Weight, g	2.28	2.14	2.16	2.07	1.89	1.89

Table A.4.7

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Andervatn (301), Finnmark, Norway (0-1)	Lille Ropelvatn (303), Finnmark, Norway (0-1)	Langvatn (87 moh) (312), Finnmark, Norway (0-1)	Coalbmejavri (316), Finnmark, Norway (0-1)	Kjeftavatn (319), Finnmark, Norway (0-1)
Lab Code:	PAS 36	PAS 37	PAS 38	PAS 39	PAS 40
HCB	**0.34**	**0.33**	**0.14**	**0.31**	**0.24**
α-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
β-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Nonachlor	n.d.	n.d.	n.d.	**0.07**	n.d.
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Chlordanes	n.d.	n.d.	n.d.	**0.07**	n.d.
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	n.d.	n.d.	n.d.	**0.20**	n.d.
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of DDT	n.d.	n.d.	n.d.	**0.20**	n.d.
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	n.d.	**0.07**	**0.17**	n.d.
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*50*	*50*	*50*	*55*	*51*
γHCH C^{13}	*62*	*66*	*69*	*75*	*68*
4,4`-DDE C^{13}	*65*	*98*	*84*	*97*	*67*
4,4`-DDT C^{13}	*88*	*79*	*77*	*66*	*102*
Weight, g	2.10	1.98	1.99	1.99	2.04

Table A.4.8

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Hestevatn (320), Finnmark, Norway (0-1)	Langvatn (302), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard, Norway (0-1)	Arresjoen (501), Svalbard, Norway (0-1)	
Lab Code:	PAS 41	PAS 42	PAS 43	PAS 44	
HCB	n.d.	**0.27**	**0.37**	**0.19**	
α-HCH	n.d.	n.d.	n.d.	n.d.	
β-HCH	n.d.	n.d.	n.d.	n.d.	
γ-HCH	n.d.	n.d.	n.d.	n.d.	
Sum of HCH	n.d.	n.d.	n.d.	n.d.	
Heptachlor	n.d.	n.d.	n.d.	n.d.	
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	
Oxychlordane	n.d.	n.d.	n.d.	n.d.	
trans-Chlordane	n.d.	n.d.	n.d.	n.d.	
cis-Chlordane	n.d.	n.d.	n.d.	n.d.	
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	
Sum of Chlordanes	n.d.	n.d.	n.d.	n.d.	
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	
4,4`-DDE	n.d.	**0.09**	**2.90**	n.d.	
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	
Sum of DDT	n.d.	**0.09**	**2.90**	n.d.	
Endrin	n.d.	n.d.	n.d.	n.d.	
Dieldrin	n.d.	n.d.	n.d.	n.d.	
Mirex	n.d.	**0.05**	**0.28**	**0.11**	
HCB C^{13}	*53*	*54*	*58*	*58*	
γ-HCH C^{13}	*60*	*73*	*68*	*71*	
4,4`-DDE C^{13}	*68*	*95*	*78*	*72*	
4,4`-DDT C^{13}	*69*	*87*	*53*	*93*	
Weight, g	2.10	2.10	2.25	1.57	

Table A.4.9

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:				
	Kongressvatn (503), Svalbard, Norway (0-1)	Richardvatn (505), Svalbard, Norway (0-1)	Asovatn (506), Svalbard, Norway (0-1)	Trolltindvatn (325), Nordland, Norway (0-1)	
Lab Code:	PAS 46	PAS 47	PAS 50	PAS 55	
HCB	**0.49**	**1.18**	**0.64**	**0.19**	
α-HCH	**0.14**	n.d.	**0.27**	n.d.	
β-HCH	**0.16**	n.d.	n.d.	n.d.	
γ-HCH	**0.10**	n.d.	n.d.	n.d.	
Sum of HCH	**0.40**	n.d.	**0.27**	n.d.	
Heptachlor	n.d.	n.d.	n.d.	n.d.	
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	
Oxychlordane	n.d.	n.d.	n.d.	n.d.	
trans-Chlordane	**0.06**	n.d.	**0.16**	n.d.	
cis-Chlordane	**0.44**	n.d.	**0.55**	n.d.	
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	
Sum of Chlordanes	**0.50**	n.d.	**0.71**	n.d.	
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	
4,4`-DDE	n.d.	n.d.	**0.72**	**0.39**	
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	
4,4`-DDD	**0.22**	n.d.	n.d.	n.d.	
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	
4,4`-DDT	n.d.	n.d.	n.d.	n.d.	
Sum of DDT	**0.22**	n.d.	**0.72**	**0.39**	
Endrin	n.d.	n.d.	n.d.	n.d.	
Dieldrin	**0.10**	n.d.	n.d.	n.d.	
Mirex	n.d.	n.d.	n.d.	n.d.	
HCB C^{13}	*82*	*72*	*85*	*85*	
γ-HCH C^{13}	*74*	*74*	*64*	*84*	
4,4`-DDE C^{13}	*77*	*75*	*89*	*87*	
4,4`-DDT C^{13}	*72*	*86*	*85*	*88*	
Weight, g	2.32	1.35	0.87	2.16	

Table A.4.10

Content of Chlorinated Pesticides in sediment, ng/g dry weight

Compound	Sample ID:			
	649/1 Holmevatn (323), Troms, Norway (0-1)	Folvatn (298), Finnmark, Norway		
Lab Code:	PAS 56	PAS 58		
HCB	**0.24**	**0.63**		
α-HCH	n.d.	n.d.		
β-HCH	n.d.	n.d.		
γ-HCH	n.d.	n.d.		
Sum of HCH	n.d.	n.d.		
Heptachlor	n.d.	n.d.		
Heptachlor epoxide	n.d.	n.d.		
Oxychlordane	n.d.	n.d.		
trans-Chlordane	n.d.	n.d.		
cis-Chlordane	n.d.	n.d.		
trans-Nonachlor	n.d.	n.d.		
cis-Nonachlor	n.d.	n.d.		
Sum of Chlordanes	n.d.	n.d.		
2,4`-DDE	n.d.	n.d.		
4,4`-DDE	**0.13**	**0.39**		
2,4`-DDD	n.d.	n.d.		
4,4`-DDD	n.d.	n.d.		
2,4`-DDT	n.d.	n.d.		
4,4`-DDT	n.d.	n.d.		
Sum of DDT	**0.13**	**0.39**		
Endrin	n.d.	n.d.		
Dieldrin	n.d.	n.d.		
Mirex	n.d.	n.d.		
HCB C^{13}	*60*	*65*		
γ-HCH C^{13}	*95*	*75*		
4,4`-DDE C^{13}	*91*	*74*		
4,4`-DDT C^{13}	*81*	*85*		
Weight, g	2.02	2.17		

69

Table A.5.1

Content of Chlorinated Pesticides in biota, ng/g wet weight

Compound	Sample ID:				
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen	Richardvatn (505), Svalbard, Norway, Fish Richardvatn
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04	PAB 05
HCB	**0.69**	**0.47**	**0.88**	**0.82**	**1.52**
α-HCH	n.d.	n.d.	n.d.	n.d.	**0.18**
β-HCH	**0.07**	n.d.	n.d.	**0.23**	**0.08**
γ-HCH	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of HCH	**0.07**	n.d.	n.d.	**0.23**	**0.26**
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	**0.50**
trans-Chlordane	**0.08**	**0.07**	**0.21**	**0.12**	**0.67**
cis-Chlordane	**0.06**	n.d.	**0.11**	**0.12**	**1.02**
trans-Nonachlor	**0.29**	**0.15**	**0.33**	**0.20**	**5.43**
cis-Nonachlor	**0.45**	**0.31**	**0.19**	**0.24**	**8.09**
Sum of Chlordanes	**0.88**	**0.53**	**0.84**	**0.68**	**15.7**
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**0.71**	**0.58**	**1.18**	**2.20**	**4.32**
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	n.d.	n.d.	n.d.	n.d.	**0.43**
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	**0.09**
4,4`-DDT	**0.17**	n.d.	n.d.	n.d.	**0.45**
Sum of DDT	**0.88**	**0.58**	**1.18**	**2.20**	**5.29**
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	**0.04**	n.d.	**0.42**	**0.27**	n.d.
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*50*	*69*	*69*	*68*	*59*
γ-HCH C^{13}	*76*	*70*	*64*	*93*	*68*
4,4`-DDE C^{13}	*83*	*64*	*81*	*63*	*89*
4,4`-DDT C^{13}	*99*	*101*	*67*	*116*	*107*
Weight, g	2.18	2.14	2.10	2.12	2.18
Lipid, %	3.51	1.53	1.70	3.47	1.76

70

Table A.5.2

Content of Chlorinated Pesticides in biota, ng/g wet weight

Compound	Sample ID:				
	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D	Richardvatn (505), Svalbard, Norway, R1
Lab Code:	PAB 06	PAB 07	PAB 08	PAB 08 D	PAB 09
HCB	**2.52**	**0.48**	**0.17**	**0.21**	**0.42**
α-HCH	**0.29**	n.d.	n.d.	n.d.	**0.06**
β-HCH	**0.07**	n.d.	n.d.	n.d.	**0.11**
γ-HCH	**0.16**	n.d.	n.d.	n.d.	**0.08**
Sum of HCH	**0.52**	n.d.	n.d.	n.d.	**0.25**
Heptachlor	n.d.	n.d.	n.d.	n.d.	**0.06**
Heptachlor epoxide	**0.27**	n.d.	n.d.	n.d.	n.d.
Oxychlordane	**1.02**	n.d.	n.d.	n.d.	**0.33**
trans-Chlordane	**0.54**	n.d.	n.d.	n.d.	**0.19**
cis-Chlordane	**0.73**	n.d.	n.d.	n.d.	**0.52**
trans-Nonachlor	**2.94**	**0.25**	n.d.	n.d.	**3.76**
cis-Nonachlor	**3.10**	**0.48**	n.d.	n.d.	**6.16**
Sum of Chlordanes	**8.33**	**0.73**	n.d.	n.d.	**11.0**
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**3.73**	**0.95**	**0.29**	**0.23**	**4.41**
2,4`-DDD	**0.09**	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	**0.39**	n.d.	n.d.	n.d.	**0.38**
2,4`-DDT	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDT	**0.34**	n.d.	n.d.	n.d.	**0.23**
Sum of DDT	**4.55**	**0.95**	**0.29**	**0.23**	**5.02**
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	**0.24**	n.d.	n.d.	n.d.	**0.17**
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*61*	*64*	*67*	*63*	*66*
γ-HCH C^{13}	*74*	*61*	*73*	*75*	*76*
4,4`-DDE C^{13}	*54*	*68*	*64*	*64*	*74*
4,4`-DDT C^{13}	*124*	*73*	*108*	*119*	*99*
Weight, g	2.13	2.18	2.16	2.22	2.66
Lipid, %	2.97	2.38	0.20	0.15	0.41

Table A.5.3

Content of Chlorinated Pesticides in biota, ng/g wet weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway, R2	Richardvatn (505), Svalbard, Norway, R4	Richardvatn (505), Svalbard, Norway, R5	Richardvatn (505), Svalbard, Norway, R6	Asovatn (506), Svalbard, Norway, A9
Lab Code:	PAB 10	PAB 11	PAB 12	PAB 13	PAB 14
HCB	**1.36**	**4.68**	**4.98**	**2.86**	**7.42**
α-HCH	**0.19**	**0.10**	**0.55**	**0.35**	**0.67**
β-HCH	n.d.	**0.11**	n.d.	**0.17**	**0.12**
γ-HCH	n.d.	n.d.	n.d.	**0.08**	**0.10**
Sum of HCH	**0.19**	**0.21**	**0.55**	**0.60**	**0.89**
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	**0.41**	**0.18**	**2.07**	**0.74**	**3.30**
trans-Chlordane	**0.44**	**0.16**	**1.74**	**0.96**	**1.56**
cis-Chlordane	**0.68**	**0.28**	**3.41**	**1.72**	**2.50**
trans-Nonachlor	**3.25**	**3.60**	**14.6**	**15.5**	**10.5**
cis-Nonachlor	**6.16**	**4.57**	**5.50**	**23.3**	**23.5**
Sum of Chlordanes	**10.9**	**8.79**	**27.3**	**42.3**	**41.3**
2,4`-DDE	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**2.47**	**5.83**	**11.6**	**14.3**	**80.0**
2,4`-DDD	n.d.	n.d.	n.d.	n.d.	n.d.
4,4`-DDD	**0.17**	**0.27**	**1.49**	**1.36**	**1.96**
2,4`-DDT	n.d.	n.d.	**0.23**	**0.17**	**0.73**
4,4`-DDT	**0.20**	**0.15**	**1.39**	**0.91**	**1.25**
Sum of DDT	**2.84**	**6.25**	**14.7**	**16.7**	**83.9**
Endrin	n.d.	**0.31**	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.	**0.14**
Mirex	n.d.	**0.32**	**0.54**	**0.53**	**0.95**
Surrogate Internal Standards, % Recovery					
HCB C^{13}	*67*	*75*	*69*	*66*	*66*
γ-HCH C^{13}	*70*	*84*	*93*	*68*	*74*
4,4`-DDE C^{13}	*62*	*78*	*58*	*70*	*68*
4,4`-DDT C^{13}	*101*	*67*	*106*	*107*	*124*
Weight, g	2.92	2.89	3.00	2.91	2.95
Lipid, %	1.45	0.76	7.24	4.18	9.50

Table A.5.4

Content of Chlorinated Pesticides in biota, ng/g wet weight

Compound	Sample ID:			
	Asovatn (506), Svalbard, Norway, A10	Asovatn (506), Svalbard, Norway, A11	Asovatn (506), Svalbard, Norway, A12	Asovatn (506), Svalbard, Norway, A13
Lab Code:	PAB 15	PAB 16	PAB 17	PAB 18
HCB	**6.78**	**1.45**	**4.47**	**4.57**
α-HCH	**0.83**	**0.10**	**0.54**	**0.57**
β-HCH	**0.27**	**0.08**	**0.10**	**0.25**
γ-HCH	**0.18**	n.d.	**0.11**	**0.16**
Sum of HCH	**1.28**	**0.18**	**0.75**	**0.98**
Heptachlor	n.d.	n.d.	n.d.	n.d.
Heptachlor epoxide	**0.10**	**0.11**	n.d.	n.d.
Oxychlordane	**2.31**	**1.57**	**1.73**	**0.86**
trans-Chlordane	**1.03**	**0.74**	**0.80**	**0.52**
cis-Chlordane	**1.67**	**1.24**	**1.05**	**0.79**
trans-Nonachlor	**6.82**	**5.68**	**5.34**	**4.54**
cis-Nonachlor	**8.38**	**6.08**	**5.14**	**3.46**
Sum of Chlordanes	**20.2**	**15.3**	**14.1**	**10.2**
2,4`-DDE	n.d.	n.d.	n.d.	n.d.
4,4`-DDE	**68.2**	**57.0**	**53.5**	**34.9**
2,4`-DDD	**0.21**	**0.08**	**0.14**	**0.11**
4,4`-DDD	**1.72**	**0.90**	**1.01**	**0.84**
2,4`-DDT	**0.71**	**0.21**	**0.15**	**0.11**
4,4`-DDT	**0.86**	**0.43**	**0.43**	**0.47**
Sum of DDT	**71.7**	**58.6**	**55.2**	**36.4**
Endrin	n.d.	n.d.	n.d.	n.d.
Dieldrin	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery				
HCB C^{13}	*63*	*61*	*61*	*55*
γ-HCH C^{13}	*71*	*73*	*75*	*68*
4,4`-DDE C^{13}	*67*	*73*	*64*	*60*
4,4`-DDT C^{13}	*73*	*108*	*119*	*112*
Weight, g	2.92	2.93	2.98	2.90
Lipid, %	10.03	1.21	6.41	7.45

Table A.6.1

Content of PAHydrocarbons in sediment, ng/g dry weight

Compound	Sample ID:					
	Vikvatn (224), Nordland, Norway (0-1)	Storvatnet (232), Nordland, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 03	PAS 06	PAS 27	PAS 33	PAS 35	PAS 35 D
Naphthalene	**24.6**	**16.6**	**21.2**	**15.8**	**34.9**	**32.0**
1-Methylnaphtalene	**26.5**	**37.1**	**44.4**	**29.0**	**45.7**	**40.6**
2-Methylnaphtalene	**17.4**	**10.8**	**35.6**	**12.6**	**34.7**	**29.8**
C2-Naphthalenes	**26.6**	**16.8**	**32.7**	**33.2**	**50.4**	**45.2**
C3-Naphthalenes	**45.7**	**27.4**	**47.8**	**47.7**	**68.3**	**53.2**
C4-Naphthalenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Acenaphthylene	**12.6**	**8.51**	**1.45**	**1.37**	**1.04**	**1.02**
Acenaphthene	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fluorene	**1.94**	**1.55**	**2.04**	n.d.	**3.43**	**3.29**
C1-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Phenanthrene	**30.8**	**14.6**	**9.77**	**8.54**	**9.78**	**8.56**
Anthracene	**6.71**	**8.46**	**2.14**	**1.31**	**2.53**	**1.98**
C1-Phenans/Anths	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Phenans/Anths	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Phenans/Anths	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C4-Phenans/Anths	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Dibenzothiophene	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C1-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fluoranthene	**69.1**	**36.2**	**8.35**	**5.56**	**9.02**	**8.62**
Pyrene	**7.56**	**6.53**	n.d.	n.d.	n.d.	n.d.
C1-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(a)anthracene	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Chrysene	**61.8**	**58.5**	n.d.	n.d.	n.d.	n.d.
C1-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Cont. table A.6.1

Content of PAHydrocarbons in sediment, ng/g dry weight

Compound	Sample ID:					
	Vikvatn (224), Nordland, Norway (0-1)	Storvatnet (232), Nordland, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 03	PAS 06	PAS 27	PAS 33	PAS 35	PAS 35 D
Benzo(b+j)fluoranthene	**95.8**	**209.0**	**22.5**	**11.7**	n.d.	n.d.
Benzo(k)fluoranthene	**21.1**	**78.4**	**5.39**	n.d.	n.d.	n.d.
Benzo(e)pyrene	**101.0**	**162.0**	**13.0**	n.d.	n.d.	n.d.
Benzo(a)pyrene	**51.0**	**78.3**	**8.69**	n.d.	n.d.	n.d.
Perylene	**983.0**	**684.0**	**1041.0**	**889.0**	**444.0**	**359.0**
Indeno(1,2,3-c,d) pyrene	**130.0**	**147.0**	n.d.	n.d.	n.d.	n.d.
Dibenz(a,h)antracene	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(g,h,i)perylene	**73.2**	**104.0**	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery						
Naphthalene d_8	*58*	*50*	*53*	*53*	*59*	*65*
Acenaphthene d_{10}	*54*	*55*	*56*	*53*	*62*	*75*
Phenanthrene d_{10}	*63*	*51*	*57*	*66*	*88*	*78*
Chrysene d_{12}	*68*	*64*	*80*	*78*	*107*	*90*
Perylene d_{12}	*69*	*62*	*62*	*73*	*81*	*85*
Weight, g	1.03	1.05	1.10	1.17	1.10	1.12

75

Table A.6.2

Content of PAHydrocarbons in sediment, ng/g dry weight

Compound	Sample ID:				
	Andervatn (301), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard, Norway (0-1)	Arresjoen (501), Svalbard, Norway (0-1)	Kongressvatn (503), Svalbard, Norway (0-1)	Richardvatn (505), Svalbard, Norway (0-1)
Lab Code:	PAS 36	PAS 43	PAS 44	PAS 46	PAS 47
Naphthalene	**13.0**	**23.5**	**16.4**	**3.86**	**11.9**
1-Methylnaphtalene	**30.6**	**39.3**	**23.0**	**6.61**	**23.6**
2-Methylnaphtalene	**15.3**	**36.6**	**16.2**	**9.48**	**12.1**
C2-Naphthalenes	**23.4**	**61.4**	**22.8**	**77.3**	**7.10**
C3-Naphthalenes	**17.6**	**64.6**	**32.3**	**108.0**	**18.5**
C4-Naphthalenes	n.d.	n.d.	n.d.	**181.0**	n.d.
Acenaphthylene	**0.55**	**0.69**	n.d.	**2.84**	n.d.
Acenaphthene	n.d.	n.d.	n.d.	n.d.	n.d.
Fluorene	**1.85**	**10.3**	n.d.	**8.02**	**1.86**
C1-Fluorenes	n.d.	**8.68**	n.d.	**22.8**	n.d.
C2-Fluorenes	n.d.	**9.91**	n.d.	n.d.	n.d.
C3-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.
Phenanthrene	**9.42**	**25.0**	**5.69**	**45.5**	**4.67**
Anthracene	n.d.	n.d.	n.d.	**9.78**	n.d.
C1-Phenans/Anths	n.d.	**63.6**	**8.35**	**109.0**	n.d.
C2-Phenans/Anths	n.d.	**34.4**	n.d.	**187.0**	n.d.
C3-Phenans/Anths	n.d.	**23.0**	n.d.	**170.0**	n.d.
C4-Phenans/Anths	n.d.	n.d.	n.d.	**72.7**	n.d.
Dibenzothiophene	n.d.	n.d.	n.d.	**5.98**	n.d.
C1-Dibenzothiophenes	n.d.	n.d.	n.d.	**19.9**	n.d.
C2-Dibenzothiophenes	n.d.	n.d.	n.d.	**20.2**	n.d.
C3-Dibenzothiophenes	n.d.	n.d.	n.d.	**2.02**	n.d.
Fluoranthene	**14.4**	**7.80**	**1.97**	**16.5**	**2.26**
Pyrene	**10.0**	**5.32**	**2.49**	**12.5**	**2.06**
C1-Flanths/Pyrs	n.d.	n.d.	n.d.	**29.9**	n.d.
C2-Flanths/Pyrs	n.d.	n.d.	n.d.	**23.9**	n.d.
C3-Flanths/Pyrs	n.d.	n.d.	n.d.	**1.64**	n.d.
Benzo(a)anthracene	**9.42**	**15.6**	n.d.	**21.6**	n.d.
Chrysene	**16.0**	**6.24**	n.d.	**6.94**	n.d.
C1-Chrysenes	n.d.	n.d.	n.d.	**65.9**	n.d.
C2-Chrysenes	n.d.	n.d.	n.d.	**81.1**	n.d.
C3-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.

76

Cont. table A.6.2

Content of PAHydrocarbons in sediment, ng/g dry weight

Compound	Sample ID:				
	Andervatn (301), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard, Norway (0-1)	Arresjoen (501), Svalbard, Norway (0-1)	Kongressvatn (503), Svalbard, Norway (0-1)	Richardvatn (505), Svalbard, Norway (0-1)
Lab Code:	PAS 36	PAS 43	PAS 44	PAS 46	PAS 47
Benzo(b+j)fluoranthene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(k)fluoranthene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(e)pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(a)pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
Perylene	n.d.	n.d.	n.d.	n.d.	**87.0**
Indeno(1,2,3-c,d) pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
Dibenz(a,h)antracene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(g,h,i)perylene	n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene d_8	*50*	*49*	*47*	*72*	*53*
Acenaphthene d_{10}	*56*	*59*	*55*	*37*	*58*
Phenanthrene d_{10}	*74*	*88*	*79*	*94*	*63*
Chrysene d_{12}	*83*	*80*	*77*	*115*	*102*
Perylene d_{12}	*101*	*70*	*65*	*96*	*78*
Weight, g	1.18	1.13	1.00	1.15	1.00

77

Table A.7.1

Content of PAHydrocarbons in biota, ng/g wet weight

Compound	Sample ID:			
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04
Naphthalene	n.d.	n.d.	n.d.	n.d.
1-Methylnaphtalene	**7.90**	**15.7**	n.d.	n.d.
2-Methylnaphtalene	**11.1**	**8.22**	n.d.	n.d.
C2-Naphtalenes	n.d.	**12.8**	n.d.	n.d.
C3-Naphtalenes	n.d.	**13.6**	n.d.	n.d.
C4-Naphtalenes	n.d.	n.d.	n.d.	n.d.
Acenaphthylene	n.d.	n.d.	n.d.	n.d.
Acenaphthene	n.d.	n.d.	n.d.	n.d.
Fluorene	n.d.	n.d.	n.d.	n.d.
C1-Fluorenes	n.d.	n.d.	n.d.	n.d.
C2-Fluorenes	n.d.	n.d.	n.d.	n.d.
C3-Fluorenes	n.d.	n.d.	n.d.	n.d.
Phenanthrene	n.d.	n.d.	n.d.	**1.26**
Anthracene	n.d.	n.d.	n.d.	n.d.
C1-Phens/Anths	n.d.	n.d.	n.d.	n.d.
C2-Phens/Anths	n.d.	n.d.	n.d.	n.d.
C3-Phens/Anths	n.d.	n.d.	n.d.	n.d.
C4-Phens/Anths	n.d.	n.d.	n.d.	n.d.
Dibenzothiophene	n.d.	n.d.	n.d.	n.d.
C1-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.
C2-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.
C3-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.
Fluoranthene	n.d.	n.d.	n.d.	n.d.
Pyrene	n.d.	n.d.	n.d.	n.d.
C1-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.
C2-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.
C3-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.
Benzo(a)anthracene	n.d.	n.d.	n.d.	n.d.
Chrysene	n.d.	n.d.	n.d.	n.d.
C1-Chrysenes	n.d.	n.d.	n.d.	n.d.
C2-Chrysenes	n.d.	n.d.	n.d.	n.d.
C3-Chrysenes	n.d.	n.d.	n.d.	n.d.

78

Cont. table A.7.1

Content of PAHydrocarbons in biota, ng/g wet weight

Compound	Sample ID:			
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04
Benzo(b+j)fluoranthene	n.d.	n.d.	n.d.	n.d.
Benzo(k)fluoranthene	n.d.	n.d.	n.d.	n.d.
Benzo(e)pyrene	n.d.	n.d.	n.d.	n.d.
Benzo(a)pyrene	n.d.	n.d.	n.d.	n.d.
Perylene	n.d.	n.d.	n.d.	n.d.
Indeno(1,2,3-c,d)pyrene	n.d.	n.d.	n.d.	n.d.
Dibenz(a,h)antracene	n.d.	n.d.	n.d.	n.d.
Benzo(g,h,i)perylene	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery				
Naphthalene d_8	*67*	*66*	*70*	*66*
Acenaphthene d_{10}	*70*	*65*	*72*	*65*
Phenanthrene d_{10}	*57*	*65*	*76*	*80*
Chrysene d_{12}	*52*	*63*	*71*	*73*
Perylene d_{12}	*78*	*50*	*80*	*57*
Weight, g	1.89	1.89	1.84	1.84
Lipid, %	3.51	1.53	1.70	3.47

79

Table A.7.2

Content of PAHydrocarbons in biota, ng/g wet weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway, Fish Richardvatn	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D
Lab Code:	PAB 05	PAB 06	PAB 07	PAB 08	PAB 08 D
Naphthalene	n.d.	n.d.	n.d.	n.d.	n.d.
1-Methylnaphtalene	n.d.	**7.23**	n.d.	n.d.	n.d.
2-Methylnaphtalene	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Naphtalenes	n.d.	**6.39**	n.d.	n.d.	n.d.
C3-Naphtalenes	n.d.	n.d.	n.d.	n.d.	n.d.
C4-Naphtalenes	n.d.	n.d.	n.d.	n.d.	n.d.
Acenaphthylene	n.d.	n.d.	n.d.	n.d.	n.d.
Acenaphthene	n.d.	n.d.	n.d.	n.d.	n.d.
Fluorene	n.d.	n.d.	n.d.	n.d.	n.d.
C1-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Fluorenes	n.d.	n.d.	n.d.	n.d.	n.d.
Phenanthrene	n.d.	n.d.	n.d.	n.d.	n.d.
Anthracene	n.d.	n.d.	n.d.	n.d.	n.d.
C1-Phens/Anths	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Phens/Anths	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Phens/Anths	n.d.	n.d.	n.d.	n.d.	n.d.
C4-Phens/Anths	n.d.	n.d.	n.d.	n.d.	n.d.
Dibenzothiophene	n.d.	n.d.	n.d.	n.d.	n.d.
C1-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Dibenzothiophenes	n.d.	n.d.	n.d.	n.d.	n.d.
Fluoranthene	n.d.	n.d.	n.d.	n.d.	n.d.
Pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
C1-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Flanths/Pyrs	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(a)anthracene	n.d.	n.d.	n.d.	n.d.	n.d.
Chrysene	n.d.	n.d.	n.d.	n.d.	n.d.
C1-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.
C2-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.
C3-Chrysenes	n.d.	n.d.	n.d.	n.d.	n.d.

80

Cont. table A.7.2

Content of PAHydrocarbons in biota, ng/g wet weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway, Fish Richardvatn	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D
Lab Code:	PAB 05	PAB 06	PAB 07	PAB 08	PAB 08 D
Benzo(b+j)fluoranthene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(k)fluoranthene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(e)pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(a)pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
Perylene	n.d.	n.d.	n.d.	n.d.	n.d.
Indeno(1,2,3-c,d)pyrene	n.d.	n.d.	n.d.	n.d.	n.d.
Dibenz(a,h)antracene	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(g,h,i)perylene	n.d.	n.d.	n.d.	n.d.	n.d.
Surrogate Internal Standards, % Recovery					
Naphthalene d_8	*56*	*66*	*57*	*55*	*63*
Acenaphthene d_{10}	*58*	*53*	*60*	*60*	*67*
Phenanthrene d_{10}	*73*	*68*	*77*	*80*	*88*
Chrysene d_{12}	*68*	*60*	*60*	*54*	*60*
Perylene d_{12}	*52*	*50*	*77*	*56*	*64*
Weight, g	1.87	1.90	1.88	1.88	1.94
Lipid, %	1.76	2.97	2.38	0.20	0.15

Table A.8.1

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Holmevatn (72), Nordland, Norway (1-0)	Valnesvatn (210), Nordland, Norway (0-1)	Vikvatn (224), Nordland, Norway (0-1)	Strumpvatn (226), Nordland (0-1)	Storvatn (227), Nordland, Norway (0-1)
Lab Code:	PAS 01	PAS 02	PAS 03	PAS 04	PAS 05
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**1.46**	n.d.	**1.21**	**2.17**	**4.62**
TeBDE #49	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #71	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #47	**22.1**	**15.5**	**19.4**	n.d.	**109.0**
TeBDE #66	n.d.	n.d.	n.d.	n.d.	n.d.
PeBDE #100	**6.18**	**4.52**	**12.7**	**20.7**	**7.17**
PeBDE #99	**19.3**	**15.9**	**14.4**	**34.4**	**48.1**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #153	**5.50**	**5.61**	n.d.	**29.8**	n.d.
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**54.5**	**41.5**	**47.7**	**87.1**	**168.9**
Weight, g	1.91	2.05	2.02	2.06	1.98

Table A.8.2

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Storvatnet (232), Nordland, Norway (0-1)	Skovatn (235), Troms, Norway (0-1)	Kapervatn (236), Troms, Norway (0-1)	Storvatn (242), Troms, Norway (0-1)	Peder Sorensens vatn (245), Troms, Norway (0-1)
Lab Code:	PAS 06	PAS 07	PAS 08	PAS 09	PAS 10
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	n.d.	n.d.	**2.03**	n.d.	n.d.
TeBDE #49	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #71	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #47	**38.5**	**47.5**	**24.2**	**12.6**	**13.8**
TeBDE #66	n.d.	n.d.	n.d.	n.d.	n.d.
PeBDE #100	**14.3**	**25.3**	**15.1**	**6.06**	**21.0**
PeBDE #99	**50.0**	**105.0**	**80.1**	**16.9**	**68.6**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	n.d.	**10.7**	n.d.	n.d.	n.d.
HexBDE #153	n.d.	**23.7**	n.d.	**5.49**	n.d.
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**102.8**	**212.2**	**121.4**	**41.1**	**103.4**
Weight, g	1.98	2.01	2.00	2.13	2.00

83

Table A.8.3

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:					
	Langfjordvatn (248), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1) D	Langvatn (257), Finnmark, Norway (0-1)	Langvatn (258), Finnmark, Norway (0-1)	Gukkesjavri (259), Fiinnmark, Norway (0-1)
Lab Code:	PAS 11	PAS 12	PAS 12 D	PAS 13	PAS 18	PAS 19
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**1.84**	n.d.	n.d.	**2.65**	**3.25**	**1.03**
TeBDE #49	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #71	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #47	**10.8**	**12.0**	**10.9**	**227.0**	**321.0**	**29.4**
TeBDE #66	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PeBDE #100	**21.1**	**1.99**	**2.05**	**127.0**	**49.0**	**6.32**
PeBDE #99	**32.0**	**9.39**	**7.65**	**646.0**	**289.0**	**35.3**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	n.d.	n.d.	n.d.	**47.8**	n.d.	n.d.
HexBDE #153	n.d.	**6.41**	**5.21**	**395.0**	**490.0**	**43.5**
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**65.7**	**29.8**	**25.8**	**1445.4**	**1152.3**	**115.6**
Weight, g	2.00	2.06	2.03	2.00	1.02	2.04

84

Table A.8.4

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Dabmutjavri (260), Finnmark, Norway (0-1)	Bakketekjavri (261), Finnmark, Norway (0-1)			
Lab Code:	PAS 20	PAS 21			
TriBDE #17	n.d.	n.d.			
TriBDE #28	1.36	n.d.			
TeBDE #49	n.d.	n.d.			
TeBDE #71	n.d.	n.d.			
TeBDE #47	17.2	105.0			
TeBDE #66	n.d.	n.d.			
PeBDE #100	4.24	17.9			
PeBDE #99	20.7	139.0			
PeBDE #85	n.d.	n.d.			
HexBDE #154	n.d.	n.d.			
HexBDE #153	8.95	140.0			
HexBDE #138	n.d.	n.d.			
HepBDE #183	n.d.	n.d.			
HepBDE #190	n.d.	n.d.			
NoBDE #208	n.d.	n.d.			
NoBDE #207	n.d.	n.d.			
NoBDE #206	n.d.	n.d.			
DeBDE #209	n.d.	n.d.			
Sum of PBDE	52.5	401.9			
Weight, g	2.00	2.05			

85

Table A.8.5

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Russevikvatn (269), Finnmark, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Lavvujavri (279), Finnmark, Norway (0-1)	Avzejavri (280), Finnmark, Norway (0-1)	Gavdnajavri (282), Finnmark, Norway (0-1)
Lab Code:	PAS 26	PAS 27	PAS 28	PAS 29	PAS 30
TriBDE #17	n.d.	n.d.	10.9	n.d.	n.d.
TriBDE #28	2.93	1.54	34.5	3.34	n.d.
TeBDE #49	n.d.	n.d.	38.8	n.d.	n.d.
TeBDE #71	n.d.	n.d.	21.6	n.d.	n.d.
TeBDE #47	65.0	19.3	3110.0	99.3	74.9
TeBDE #66	n.d.	n.d.	106.0	2.95	14.6
PeBDE #100	27.6	11.4	944.0	39.1	23.3
PeBDE #99	69.8	27.2	4208.0	159.0	105.0
PeBDE #85	n.d.	n.d.	264.0	n.d.	n.d.
HexBDE #154	9.43	n.d.	333.0	13.7	11.9
HexBDE #153	13.2	n.d.	498.0	26.5	35.7
HexBDE #138	n.d.	n.d.	35.1	n.d.	n.d.
HepBDE #183	n.d.	n.d.	21.5	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	188.0	59.5	9625.3	344.0	265.5
Weight, g	2.11	2.28	2.09	2.06	2.18

86

Table A.8.6

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:					
	Ravdojavri (283), Finnmark, Norway (0-1)	Vuoddajavri (284), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Ratjern (291), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 31	PAS 32	PAS 33	PAS 34	PAS 35	PAS 35 D
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**1.48**	n.d.	**2.77**	**2.80**	**3.56**	**2.98**
TeBDE #49	**2.34**	n.d.	n.d.	**1.77**	n.d.	n.d.
TeBDE #71	**2.29**	n.d.	n.d.	**1.28**	n.d.	n.d.
TeBDE #47	**30.1**	**8.70**	**46.4**	**79.8**	**105.0**	**110.0**
TeBDE #66	n.d.	n.d.	n.d.	**12.1**	**10.4**	**9.9**
PeBDE #100	**18.4**	**8.21**	**8.80**	**16.4**	**30.2**	**25.3**
PeBDE #99	**34.8**	**17.5**	**24.0**	**49.5**	**127.0**	**115.0**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	n.d.	n.d.	n.d.	**3.87**	**9.23**	**8.56**
HexBDE #153	**10.6**	n.d.	n.d.	**10.6**	**22.3**	**19.6**
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**100.0**	**34.4**	**82.0**	**178.1**	**307.7**	**291.3**
Weight, g	2.23	2.12	2.17	2.10	1.95	1.93

87

Table A.8.7

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Andervatn (301), Finnmark, Norway (0-1)	Lille Ropelvatn (303), Finnmark, Norway (0-1)	Langvatn (87 moh) (312), Finnmark, Norway (0-1)	Coalbmejavri (316), Finnmark, Norway (0-1)	Kjeftavatn (319), Finnmark, Norway (0-1)
Lab Code:	PAS 36	PAS 37	PAS 38	PAS 39	PAS 40
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**1.78**	**1.61**	**1.33**	n.d.	**1.70**
TeBDE #49	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #71	n.d.	n.d.	n.d.	n.d.	n.d.
TeBDE #47	**59.8**	**42.3**	**16.2**	**8.24**	**25.0**
TeBDE #66	**17.5**	**3.85**	**5.57**	**2.36**	**2.08**
PeBDE #100	**20.0**	**29.1**	**11.0**	**139.0**	**10.8**
PeBDE #99	**36.7**	**75.6**	**20.3**	**106.0**	**14.2**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	**6.51**	**15.4**	n.d.	n.d.	**3.02**
HexBDE #153	**4.65**	**13.5**	n.d.	n.d.	**7.67**
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**146.9**	**181.4**	**54.4**	**255.6**	**64.5**
Weight, g	2.15	2.10	2.03	1.99	2.02

88

Table A.8.8

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Hestevatn (320), Finnmark, Norway (0-1)	Langvatn (302), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard, Norway (0-1)	Arressjoen (501), Svalbard, Norway (0-1)	Kongressvatn (503), Svalbard, Norway (0-1)
Lab Code:	PAS 41	PAS 42	PAS 43	PAS 44	PAS 46
TriBDE #17	n.d.	n.d.	**46.4**	**2.60**	n.d.
TriBDE #28	n.d.	**1.90**	**31.8**	**7.34**	**2.02**
TeBDE #49	n.d.	n.d.	**23.0**	**9.18**	n.d.
TeBDE #71	n.d.	n.d.	**16.9**	**3.88**	n.d.
TeBDE #47	**3.76**	**33.9**	**320.0**	**852.0**	**13.4**
TeBDE #66	n.d.	**1.95**	**29.8**	**14.3**	**6.72**
PeBDE #100	**38.0**	**23.1**	**21.1**	**224.0**	**3.38**
PeBDE #99	**36.6**	**42.4**	**40.6**	**1085.0**	n.d.
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	n.d.	n.d.	**9.69**	**44.9**	n.d.
HexBDE #153	n.d.	n.d.	**24.4**	**140**	n.d.
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	**7.79**	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**78.4**	**103.2**	**571.4**	**2383.4**	**25.5**
Weight, g	2.13	2.10	2.26	1.58	2.29

89

Table A.8.9

Content of Polybrominated diphenyl ethers in sediment, ng/kg dry weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway (0-1)	Asovatn (506), Svalbard, Norway (0-1)	Trolltindvatn (325), Nordland, Norway (0-1)	649/1 Holmevatn (323), Troms, Norway (0-1)	Folvatn (298), Finnmark, Norway
Lab Code:	PAS 47	PAS 50	PAS 55	PAS 56	PAS 58
TriBDE #17	n.d.	n.d.	n.d.	n.d.	**4.16**
TriBDE #28	**1.75**	**4.46**	n.d.	n.d.	**9.63**
TeBDE #49	n.d.	n.d.	n.d.	n.d.	**22.0**
TeBDE #71	n.d.	n.d.	n.d.	n.d.	**12.8**
TeBDE #47	**59.1**	**247**	**35.6**	**42.9**	**870.0**
TeBDE #66	**1.06**	**90.1**	**7.78**	n.d.	**47.5**
PeBDE #100	**14.5**	**83.3**	**20.3**	**18.4**	**485.0**
PeBDE #99	**42.9**	**419.0**	**37.4**	**24.8**	**2010.0**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	**6.09**	**51.1**	n.d.	n.d.	**1920.0**
HexBDE #153	**6.66**	**67.5**	n.d.	n.d.	**391.0**
HexBDE #138	n.d.	n.d.	n.d.	n.d.	**45.7**
HepBDE #183	**8.94**	n.d.	n.d.	n.d.	**14.2**
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**141.0**	**962.0**	**101.1**	**86.2**	**5831.9**
Weight, g	1.32	0.84	2.16	1.99	2.19

90

Table A.9.1

Content of Polybrominated diphenyl ethers in biota, ng/kg wet weight

Compound	Sample ID:				
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen	Richardvatn (505), Svalbard, Norway, Fish Richardvatn
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04	PAB 05
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**2.52**	**1.12**	**46.5**	**8.55**	**10.0**
TeBDE #49	**12.8**	**8.16**	**23.0**	**6.83**	**9.72**
TeBDE #71	**13.6**	**4.24**	**24.4**	**10.1**	**14.8**
TeBDE #47	**164.0**	**127.0**	**1429.0**	**129.0**	**198.0**
TeBDE #66	**11.5**	**9.19**	**46.3**	**9.38**	**19.9**
PeBDE #100	**124.0**	**32.3**	**133.0**	**29.5**	**53.9**
PeBDE #99	**95.2**	**87.8**	**140.0**	**60.8**	**86.6**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	**95.6**	**20.5**	**35.5**	**14.4**	**22.7**
HexBDE #153	**40.6**	n.d.	**32.5**	n.d.	n.d.
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	**12.3**	n.d.	**5.75**	**11.0**	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**572.2**	**290.2**	**1916.0**	**279.7**	**415.6**
Weight, g	2.17	2.23	2.14	2.08	2.11
Lipid, %	3.51	1.53	1.70	3.47	1.76

Table A.9.2

Content of Polybrominated diphenyl ethers in biota, ng/kg wet weight

Compound	Sample ID:				
	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D	Richardvatn (505), Svalbard, Norway, R1
Lab Code:	PAB 06	PAB 07	PAB 08	PAB 08 D	PAB 09
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**16.5**	**1.25**	n.d.	n.d.	**18.4**
TeBDE #49	**16.6**	**5.57**	n.d.	n.d.	n.d.
TeBDE #71	**14.4**	**3.10**	n.d.	n.d.	n.d.
TeBDE #47	**704.0**	**123.0**	**15.3**	**15.7**	**258.0**
TeBDE #66	**35.5**	**5.43**	n.d.	n.d.	n.d.
PeBDE #100	**112.0**	**44.2**	**5.00**	**5.40**	**54.8**
PeBDE #99	**226.0**	**49.7**	**6.98**	**8.63**	**123.0**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	**36.8**	**21.9**	n.d.	n.d.	**26.1**
HexBDE #153	**13.1**	n.d.	n.d.	n.d.	**11.2**
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	**9.38**	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**1174.9**	**263.5**	**27.3**	**29.7**	**491.5**
Weight, g	2.08	2.10	2.15	2.12	2.68
Lipid, %	2.97	2.38	0.20	0.15	0.41

Table A.9.3

Content of Polybrominated diphenyl ethers in biota, ng/kg wet weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway, R2	Richardvatn (505), Svalbard, Norway, R4	Richardvatn (505), Svalbard, Norway, R5	Richardvatn (505), Svalbard, Norway, R6	Asovatn (506), Svalbard, Norway, A9
Lab Code:	PAB 10	PAB 11	PAB 12	PAB 13	PAB 14
TriBDE #17	n.d.	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**13.8**	**11.2**	**57.0**	**37.0**	**75.5**
TeBDE #49	n.d.	**3.70**	**18.2**	**17.4**	**35.7**
TeBDE #71	n.d.	**16.3**	**26.1**	**24.8**	**35.7**
TeBDE #47	**236.0**	**322.0**	**503.0**	**358.0**	**2905.0**
TeBDE #66	n.d.	**15.5**	**70.0**	**48.5**	**125.0**
PeBDE #100	**37.6**	**119.0**	**144.0**	**189.0**	**394.0**
PeBDE #99	**135.0**	**157.0**	**240.0**	**364.0**	**1064.0**
PeBDE #85	n.d.	n.d.	n.d.	n.d.	n.d.
HexBDE #154	**21.6**	**51.3**	**67.4**	**73.7**	**148.0**
HexBDE #153	**10.7**	**32.4**	**34.5**	**31.7**	**169.0**
HexBDE #138	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**454.7**	**728.4**	**1160.2**	**1144.1**	**4951.9**
Weight, g	2.90	2.89	2.96	2.89	2.95
Lipid, %	1.45	0.76	7.24	4.18	9.50

93

Table A.9.4

Content of Polybrominated diphenyl ethers in biota, ng/kg wet weight

Compound	Sample ID:			
	Asovatn (506), Svalbard, Norway, A10	Asovatn (506), Svalbard, Norway, A11	Asovatn (506), Svalbard, Norway, A12	Asovatn (506), Svalbard, Norway, A13
Lab Code:	PAB 15	PAB 16	PAB 17	PAB 18
TriBDE #17	n.d.	n.d.	n.d.	n.d.
TriBDE #28	**65.7**	**37.4**	**42.4**	**36.1**
TeBDE #49	n.d.	n.d.	n.d.	n.d.
TeBDE #71	n.d.	n.d.	n.d.	n.d.
TeBDE #47	**2453.0**	**1818.0**	**1893.0**	**1371.0**
TeBDE #66	n.d.	n.d.	n.d.	n.d.
PeBDE #100	**389.0**	**282.0**	**304.0**	**184.0**
PeBDE #99	**934.0**	**745.0**	**713.0**	**455.0**
PeBDE #85	n.d.	n.d.	n.d.	n.d.
HexBDE #154	**132.0**	**124.0**	**97.2**	**67.3**
HexBDE #153	**157.0**	**126.0**	**128.0**	**78.2**
HexBDE #138	n.d.	n.d.	n.d.	n.d.
HepBDE #183	n.d.	n.d.	n.d.	n.d.
HepBDE #190	n.d.	n.d.	n.d.	n.d.
NoBDE #208	n.d.	n.d.	n.d.	n.d.
NoBDE #207	n.d.	n.d.	n.d.	n.d.
NoBDE #206	n.d.	n.d.	n.d.	n.d.
DeBDE #209	n.d.	n.d.	n.d.	n.d.
Sum of PBDE	**4130.7**	**3132.4**	**3177.6**	**2191.6**
Weight, g	2.89	2.89	2.87	2.89
Lipid, %	10.03	1.21	6.41	7.45

94

Table A.10.1

Content of Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in sediment, ng/kg dry weight

Compound	Sample ID:			
	Valnesvatn (210), Nordland, Norway (0-1)	Langvatn (257), Finnmark, Norway (0-1)	Bakketekjavri (261), Finnmark, Norway (0-1)	Ravdojavri (283), Finnmark, Norway (0-1)
Lab Code:	PAS 02	PAS 13	PAS 21	PAS 31
2,3,7,8-TCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDD	**12.4**	**5.43**	n.d.	n.d.
1,2,3,4,7,8-HxCDD	**18.0**	**5.36**	n.d.	n.d.
1,2,3,6,7,8- HxCDD	**9.39**	**5.52**	n.d.	n.d.
1,2,3,7,8,9- HxCDD	**17.0**	**19.8**	**10.2**	n.d.
1,2,3,4,6,7,8-HpCDD	**247.0**	**123.0**	**16.1**	**6.24**
OCDD	**2615.0**	**1137.0**	**145.0**	**25.3**
2,3,7,8-TCDF	**4.07**	**1.32**	**0.41**	**0.19**
1,2,3,7,8-PeCDF	**10.3**	**4.78**	**1.24**	**0.57**
2,3,4,7,8-PeCDF	**12.5**	**5.77**	**1.58**	**0.88**
1,2,3,4,7,8-HxCDF	**21.1**	**10.8**	**2.80**	**1.38**
1,2,3,6,7,8- HxCDF	**14.6**	**8.10**	**1.49**	**0.77**
2,3,4,6,7,8-HxCDF	**15.1**	**7.53**	**1.74**	**0.99**
1,2,3,7,8,9-HxCDF	**5.17**	**2.87**	**0.73**	**0.42**
1,2,3,4,6,7,8-HpCDF	**99.5**	**50.2**	**11.5**	**8.41**
1,2,3,4,7,8,9-HpCDF	**10.7**	**6.03**	**1.18**	**0.85**
OCDF	**151.0**	**87.7**	**20.2**	**15.7**
Total Concentration in TEQ	**33.5**	**16.6**	**2.89**	**1.00**
Surrogate Internal Standards, % Recovery				
($^{13}C_{12}$)2,3,7,8-TCDD	*73*	*80*	*77*	*85*
($^{13}C_{12}$)2,3,7,8-TCDF	*77*	*75*	*81*	*91*
($^{13}C_{12}$)1,2,3,7,8-PeCDD	*81*	*89*	*90*	*80*
($^{13}C_{12}$)1,2,3,7,8-PeCDF	*80*	*83*	*85*	*90*
($^{13}C_{12}$)1,2,3,6,7,8- HxCDD	*75*	*79*	*71*	*88*
($^{13}C_{12}$)1,2,3,6,7,8- HxCDF	*82*	*85*	*83*	*79*
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDD	*80*	*82*	*89*	*75*
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDF	*79*	*84*	*78*	*77*
($^{13}C_{12}$)OCDD	*81*	*88*	*80*	*83*
Weight, g	5.43	4.94	7.47	8.75

95

Table A.10.2

Content of Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in sediment, ng/kg dry weight

Compound	Sample ID:				
	Ratjern (291), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D	Andervatn (301), Finnmark, Norway (0-1)	Lille Ropelvatn (303), Finnmark, Norway (0-1)
Lab Code:	PAS 34	PAS 35	PAS 35 D	PAS 36	PAS 37
2,3,7,8-TCDD	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDD	n.d.	n.d.	n.d.	**6.05**	**3.99**
1,2,3,4,7,8-HxCDD	n.d.	n.d.	n.d.	**3.46**	**2.56**
1,2,3,6,7,8- HxCDD	n.d.	n.d.	n.d.	**4.43**	**2.46**
1,2,3,7,8,9- HxCDD	n.d.	n.d.	n.d.	**9.32**	**9.76**
1,2,3,4,6,7,8-HpCDD	**39.5**	**7.55**	**6.52**	**19.5**	**25.8**
OCDD	**524.0**	**43.8**	**42.0**	**38.5**	**158.0**
2,3,7,8-TCDF	**0.57**	**0.58**	**0.56**	**4.50**	**2.47**
1,2,3,7,8-PeCDF	**0.82**	**0.90**	**1.13**	**12.8**	**5.72**
2,3,4,7,8-PeCDF	**0.90**	**1.23**	**1.25**	**16.5**	**7.25**
1,2,3,4,7,8-HxCDF	**2.15**	n.d.	n.d.	**27.0**	**13.5**
1,2,3,6,7,8- HxCDF	**1.19**	n.d.	n.d.	**22.3**	**7.55**
2,3,4,6,7,8-HxCDF	**1.28**	n.d.	n.d.	**24.0**	**10.3**
1,2,3,7,8,9-HxCDF	**0.63**	n.d.	n.d.	**9.22**	**4.55**
1,2,3,4,6,7,8-HpCDF	**7.20**	**7.56**	**6.63**	**94.8**	**43.0**
1,2,3,4,7,8,9-HpCDF	**1.17**	n.d.	n.d.	**18.2**	**8.38**
OCDF	**11.4**	**8.83**	**8.03**	**42.0**	**57.4**
Total Concentration in TEQ	**1.61**	**0.88**	**0.88**	**26.7**	**14.0**
Surrogate Internal Standards, % Recovery					
($^{13}C_{12}$)2,3,7,8-TCDD	*74*	*81*	*77*	*75*	*79*
($^{13}C_{12}$)2,3,7,8-TCDF	*78*	*79*	*85*	*83*	*70*
($^{13}C_{12}$)1,2,3,7,8-PeCDD	*81*	*74*	*84*	*78*	*81*
($^{13}C_{12}$)1,2,3,7,8-PeCDF	*88*	*83*	*87*	*84*	*77*
($^{13}C_{12}$)1,2,3,6,7,8- HxCDD	*79*	*80*	*89*	*88*	*85*
($^{13}C_{12}$)1,2,3,6,7,8- HxCDF	*85*	*85*	*96*	*77*	*80*
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDD	*80*	*82*	*85*	*80*	*83*
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDF	*82*	*78*	*84*	*79*	*90*
($^{13}C_{12}$)OCDD	*88*	*79*	*77*	*83*	*89*
Weight, g	9.04	1.88	1.85	21.65	8.93

96

Table A.10.3

Content of Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in sediment, ng/kg dry weight

Compound	Sample ID:			
	Langvatn (87 moh) (312), Finnmark, Norway (0-1)	Coalbmejavri (316), Finnmark, Norway (0-1)	649/1 Holmevatn (323), Troms, Norway (0-1)	Folvatn (298), Finnmark, Norway
Lab Code:	PAS 38	PAS 39	PAS 56	PAS 58
2,3,7,8-TCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDD	**3.82**	**5.78**	n.d.	n.d.
1,2,3,4,7,8-HxCDD	**8.72**	**2.96**	n.d.	n.d.
1,2,3,6,7,8- HxCDD	**4.75**	**3.18**	n.d.	n.d.
1,2,3,7,8,9- HxCDD	**25.4**	**31.3**	n.d.	n.d.
1,2,3,4,6,7,8-HpCDD	**65.7**	**80.2**	**26.2**	**38.8**
OCDD	**793.0**	**998.0**	**114.0**	**444.0**
2,3,7,8-TCDF	**2.13**	**2.84**	**0.37**	**1.14**
1,2,3,7,8-PeCDF	**3.31**	**4.45**	**2.80**	**2.08**
2,3,4,7,8-PeCDF	**4.56**	**6.90**	**2.88**	**2.23**
1,2,3,4,7,8-HxCDF	**8.11**	**11.6**	**5.99**	**4.68**
1,2,3,6,7,8- HxCDF	**5.01**	**9.74**	**3.33**	**2.49**
2,3,4,6,7,8-HxCDF	**4.55**	**6.90**	**3.31**	**2.82**
1,2,3,7,8,9-HxCDF	**1.89**	**2.72**	**1.68**	**1.23**
1,2,3,4,6,7,8-HpCDF	**21.4**	**39.8**	**25.3**	**19.5**
1,2,3,4,7,8,9-HpCDF	**3.15**	**5.64**	**2.45**	**1.91**
OCDF	**32.5**	**52.7**	**41.8**	**37.8**
Total Concentration in TEQ	**13.3**	**17.9**	**3.61**	**3.11**
Surrogate Internal Standards, % Recovery				
$(^{13}C_{12})$2,3,7,8-TCDD	*78*	*85*	*70*	*82*
$(^{13}C_{12})$2,3,7,8-TCDF	*80*	*82*	*79*	*85*
$(^{13}C_{12})$1,2,3,7,8-PeCDD	*77*	*80*	*76*	*80*
$(^{13}C_{12})$1,2,3,7,8-PeCDF	*69*	*79*	*80*	*81*
$(^{13}C_{12})$1,2,3,6,7,8- HxCDD	*85*	*84*	*75*	*79*
$(^{13}C_{12})$1,2,3,6,7,8- HxCDF	*74*	*77*	*83*	*77*
$(^{13}C_{12})$1,2,3,4,6,7,8-HpCDD	*79*	*82*	*81*	*80*
$(^{13}C_{12})$1,2,3,4,6,7,8-HpCDF	*83*	*80*	*77*	*89*
$(^{13}C_{12})$OCDD	*80*	*77*	*80*	*90*
Weight, g	7.94	5.78	3.54	11.42

97

Table A.11.1

Content of Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in biota, ng/kg wet weight

Compound	Sample ID:			
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04
2,3,7,8-TCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,4,7,8-HxCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,6,7,8- HxCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8,9- HxCDD	n.d.	n.d.	n.d.	n.d.
1,2,3,4,6,7,8-HpCDD	n.d.	n.d.	n.d.	n.d.
OCDD	n.d.	n.d.	n.d.	n.d.
2,3,7,8-TCDF	n.d.	n.d.	**0.37**	n.d.
1,2,3,7,8-PeCDF	**0.33**	**0.39**	**0.67**	**0.52**
2,3,4,7,8-PeCDF	**0.25**	**0.35**	**0.29**	**0.54**
1,2,3,4,7,8-HxCDF	n.d.	n.d.	n.d.	n.d.
1,2,3,6,7,8- HxCDF	n.d.	n.d.	n.d.	n.d.
2,3,4,6,7,8-HxCDF	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8,9-HxCDF	n.d.	n.d.	n.d.	n.d.
1,2,3,4,6,7,8-HpCDF	**0.62**	**0.85**	**0.83**	**0.45**
1,2,3,4,7,8,9-HpCDF	n.d.	n.d.	n.d.	n.d.
OCDF	n.d.	n.d.	n.d.	n.d.
Total Concentration in TEQ	**0.15**	**0.20**	**0.22**	**0.30**
Surrogate Internal Standards, % Recovery				
$(^{13}C_{12})$2,3,7,8-TCDD	*77*	*90*	*81*	*79*
$(^{13}C_{12})$2,3,7,8-TCDF	*91*	*89*	*80*	*83*
$(^{13}C_{12})$1,2,3,7,8-PeCDD	*86*	*78*	*83*	*81*
$(^{13}C_{12})$1,2,3,7,8-PeCDF	*89*	*81*	*85*	*77*
$(^{13}C_{12})$1,2,3,6,7,8- HxCDD	*92*	*88*	*83*	*80*
$(^{13}C_{12})$1,2,3,6,7,8- HxCDF	*79*	*77*	*79*	*81*
$(^{13}C_{12})$1,2,3,4,6,7,8-HpCDD	*83*	*80*	*80*	*77*
$(^{13}C_{12})$1,2,3,4,6,7,8-HpCDF	*80*	*84*	*81*	*89*
$(^{13}C_{12})$OCDD	*90*	*89*	*88*	*90*
Weight, g	2.13	2.21	2.13	2.05
Lipid, %	3.51	1.53	1.70	3.47

98

Table A.11.2

Content of Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in biota, ng/kg wet weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway, Fish Richardvatn	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D
Lab Code:	PAB 05	PAB 06	PAB 07	PAB 08	PAB 08 D
2,3,7,8-TCDD	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDD	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,4,7,8-HxCDD	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,6,7,8- HxCDD	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8,9- HxCDD	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,4,6,7,8-HpCDD	n.d.	n.d.	n.d.	n.d.	n.d.
OCDD	n.d.	n.d.	n.d.	n.d.	n.d.
2,3,7,8-TCDF	n.d.	**0.48**	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDF	**0.20**	**0.46**	n.d.	**0.29**	**0.31**
2,3,4,7,8-PeCDF	n.d.	**0.41**	n.d.	n.d.	n.d.
1,2,3,4,7,8-HxCDF	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,6,7,8- HxCDF	n.d.	n.d.	n.d.	n.d.	n.d.
2,3,4,6,7,8-HxCDF	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,7,8,9-HxCDF	n.d.	n.d.	n.d.	n.d.	n.d.
1,2,3,4,6,7,8-HpCDF	**0.26**	**0.50**	n.d.	**0.28**	**0.36**
1,2,3,4,7,8,9-HpCDF	n.d.	n.d.	n.d.	n.d.	n.d.
OCDF	n.d.	n.d.	n.d.	n.d.	n.d.
Total Concentration in TEQ	**0.013**	**0.28**	n.d.	**0.017**	**0.019**
Surrogate Internal Standards, % Recovery					
($^{13}C_{12}$)2,3,7,8-TCDD	*90*	*84*	*79*	*80*	*78*
($^{13}C_{12}$)2,3,7,8-TCDF	*81*	*88*	*83*	*85*	*80*
($^{13}C_{12}$)1,2,3,7,8-PeCDD	*88*	*82*	*73*	*84*	*85*
($^{13}C_{12}$)1,2,3,7,8-PeCDF	*91*	*75*	*88*	*77*	*80*
($^{13}C_{12}$)1,2,3,6,7,8- HxCDD	*88*	*78*	*91*	*75*	*82*
($^{13}C_{12}$)1,2,3,6,7,8- HxCDF	*85*	*77*	*79*	*82*	*79*
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDD	*80*	*80*	*85*	*80*	*78*
($^{13}C_{12}$)1,2,3,4,6,7,8-HpCDF	*79*	*74*	*80*	*85*	*84*
($^{13}C_{12}$)OCDD	*84*	*85*	*83*	*89*	*86*
Weight, g	2.09	2.08	2.09	2.15	2.10
Lipid, %	1.76	2.97	2.38	0.20	0.15

99

Table A.12.1

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID:				
	Holmevatn (72), Nordland, Norway (1-0)	Valnesvatn (210), Nordland, Norway (0-1)	Vikvatn (224), Nordland, Norway (0-1)	Strumpvatn (226), Nordland (0-1)	Storvatn (227), Nordland, Norway (0-1)
Lab Code:	PAS 01	PAS 02	PAS 03	PAS 04	PAS 05
Parlar#26	n.d.	n.d.	n.d.	**56.5**	n.d.
Parlar#50	n.d.	**114.0**	n.d.	**135.0**	**42.4**
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	n.d.	**114.0**	n.d.	**191.5**	**42.4**
Weight, g	1.55	2.00	2.10	2.07	2.19

Table A.12.2

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID:				
	Storvatnet (232), Nordland, Norway (0-1)	Skovatn (235), Troms, Norway (0-1)	Kapervatn (236), Troms, Norway (0-1)	Storvatn (242), Troms, Norway (0-1)	Peder Sorensens vatn (245), Troms, Norway (0-1)
Lab Code:	PAS 06	PAS 07	PAS 08	PAS 09	PAS 10
Parlar#26	n.d.	n.d.	n.d.	n.d.	n.d.
Parlar#50	**86.8**	**41.3**	**55.3**	n.d.	**34.8**
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	**86.8**	**41.3**	**55.3**	n.d.	**34.8**
Weight, g	2.12	2.09	2.02	2.03	2.02

Table A.12.3

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID:					
	Langfjordvatn (248), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1)	Josvatn (250), Troms, Norway (0-1) D	Langvatn (257), Finnmark, Norway (0-1)	Langvatn (258), Finnmark, Norway (0-1)	Gukkesjavri (259), Finnmark, Norway (0-1)
Lab Code:	PAS 11	PAS 12	PAS 12 D	PAS 13	PAS 18	PAS 19
Parlar#26	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Parlar#50	**107.0**	n.d.	n.d.	n.d.	n.d.	**38.0**
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	**107.0**	n.d.	n.d.	n.d.	n.d.	**38.0**
Weight, g	2.05	2.10	2.00	1.93	0.73	2.00

100

Table A.12.4

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID: Dabmutjavri (260), Finnmark, Norway (0-1)	Bakketekjavri (261), Finnmark, Norway (0-1)			
Lab Code:	PAS 20	PAS 21			
Parlar#26	n.d.	n.d.			
Parlar#50	n.d.	n.d.			
Parlar#62	n.d.	n.d.			
Sum of Tox	n.d.	n.d.			
Weight, g	1.96	2.06			

Table A.12.5

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID: Russevikvatn (269), Finnmark, Norway (0-1)	Galgutjavri (274), Finnmark, Norway (0-1)	Lavvujavri (279), Finnmark, Norway (0-1)	Avzejavri (280), Finnmark, Norway (0-1)	Gavdnajavri (282), Finnmark, Norway (0-1)
Lab Code:	PAS 26	PAS 27	PAS 28	PAS 29	PAS 30
Parlar#26	n.d.	n.d.	n.d.	n.d.	n.d.
Parlar#50	n.d.	n.d.	n.d.	n.d.	n.d.
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	n.d.	n.d.	n.d.	n.d.	n.d.
Weight, g	2.11	2.28	2.09	2.06	2.14

Table A.12.6

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID: Ravdojavri (283), Finnmark, Norway (0-1)	Vuoddajavri (284), Finnmark, Norway (0-1)	Syltevikvatn (285), Finnmark, Norway (0-1)	Ratjern (291), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1)	Odevatn (300), Finnmark, Norway (0-1) D
Lab Code:	PAS 31	PAS 32	PAS 33	PAS 34	PAS 35	PAS 35 D
Parlar#26	n.d.	n.d.	n.d.	**44.2**	n.d.	n.d.
Parlar#50	**32.9**	n.d.	n.d.	**187.5**	n.d.	n.d.
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	**32.9**	n.d.	n.d.	**231.7**	n.d.	n.d.
Weight, g	2.28	2.14	2.16	2.07	1.89	1.89

Table A.12.7

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID: Andervatn (301), Finnmark, Norway (0-1)	Lille Ropelvatn (303), Finnmark, Norway (0-1)	Langvatn (87 moh) (312), Finnmark, Norway (0-1)	Coalbmejavri (316), Finnmark, Norway (0-1)	Kjeftavatn (319), Finnmark, Norway (0-1)
Lab Code:	PAS 36	PAS 37	PAS 38	PAS 39	PAS 40
Parlar#26	n.d.	**9.34**	**7.89**	**20.4**	**14.6**
Parlar#50	**21.4**	**52.2**	**45.2**	**87.4**	**32.1**
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	**21.4**	**61.5**	**53.1**	**107.8**	**46.7**
Weight, g	2.10	1.98	1.99	1.99	2.04

Table A.12.8

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID: Hestevatn (320), Finnmark, Norway (0-1)	Langvatn (302), Finnmark, Norway (0-1)	Ellasjoen (402), Svalbard, Norway (0-1)	Arressjoen (501), Svalbard, Norway (0-1)	Kongressvatn (503), Svalbard, Norway (0-1)
Lab Code:	PAS 41	PAS 42	PAS 43	PAS 44	PAS 46
Parlar#26	**12.9**	**16.0**	**19.3**	n.d.	n.d.
Parlar#50	**58.2**	**58.5**	**21.3**	**10.6**	**5.82**
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	**71.1**	**74.5**	**40.6**	**10.6**	**5.82**
Weight, g	2.10	2.10	2.25	1.57	2.32

Table A.12.9

Content of toxaphenes in sediment, ng/kg dry weight

Compound	Sample ID: Richardvatn (505), Svalbard, Norway (0-1)	Asovatn (506), Svalbard, Norway (0-1)	Trolltindvatn (325), Nordland, Norway (0-1)	649/1 Holmevatn (323), Troms, Norway (0-1)	Folvatn (298), Finnmark, Norway
Lab Code:	PAS 47	PAS 50	PAS 55	PAS 56	PAS 58
Parlar#26	n.d.	n.d.	n.d.	n.d.	**12.7**
Parlar#50	**122.0**	n.d.	**22.5**	**10.9**	**68.2**
Parlar#62	n.d.	n.d.	n.d.	n.d.	n.d.
Sum of Tox	**122.0**	n.d.	**22.5**	**10.9**	**80.9**
Weight, g	1.35	0.87	2.16	2.02	2.17

Table A.13.1

Content of toxaphenes in biota, ng/kg wet weight

Compound	Sample ID:			
	Valnesvatn (210), Nordland, Norway, Fish Valnes	Langvatn (257), Finnmark, Norway, Fish Langvatn	Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	Oyangen (402) Svalbard, Norway, Fish Oyangen
Lab Code:	PAB 01	PAB 02	PAB 03	PAB 04
Parl 26	**200.0**	**97.1**	**324.0**	**70.9**
Parl 50	**958.0**	**383.0**	**1012.0**	**152.0**
Parl 62	**181.0**	**76.2**	**185.0**	n.d.
Sum of Tox	**1339.0**	**556.2**	**1521.0**	**222.9**
Weight, g	2.18	2.14	2.10	2.12
Lipid, %	3.51	1.53	1.70	3.47

Table A.13.2

Content of toxaphenes in biota, ng/kg wet weight

Compound	Sample ID:				
	Richardvatn (505), Svalbard, Norway, Fish Richardvatn	Asovatn (506), Svalbard, Norway, Fish Asovatn	Holmevatn (323), Troms, Norway, Fish Holmevatn	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D
Lab Code:	PAB 05	PAB 06	PAB 07	PAB 08	PAB 08 D
Parl 26	**1914.0**	**1348.0**	**97.6**	**9.26**	**10.5**
Parl 50	**8853.0**	**3030.0**	**268.0**	**22.1**	**19.0**
Parl 62	**3012.0**	**725.0**	n.d.	n.d.	n.d.
Sum of Tox	**13779.0**	**5103.0**	**365.6**	**31.3**	**29.5**
Weight, g	2.18	2.13	2.18	2.16	2.22
Lipid, %	1.76	2.97	2.38	0.20	0.15

103

Table 14

Content of Metals in Sediment, mg/kg dry wt

Sample ID:	As	Cd	Co	Cr	Cu	Hg	Ni	Pb	Se	Zn
Langvatn (257), Finnmark, Norway (0-1)	12.4	0.99	203	17.0	38.8	0.141	21.9	81.5	4.65	105
Bakketekjavri (261), Finnmark, Norway (0-1)	10.8	0.85	370	23.8	45.5	0.103	23.5	53.9	4.84	127
Bakketekjavri (261), Finnmark, Norway (0-1) D	11.7	0.75	388	27.2	46.1	0.091	27.2	56.1	4.15	134
Ellasjoen (402), Svalbard, Norway (0-1)	11.1	2.28	41.7	106	26.0	0.105	62.4	94.3	2.20	51.6
Kongressvatn (503), Svalbard, Norway (0-1)	8.36	0.45	7.60	51.7	4.48	0.044	14.7	25.5	1.00	64.5
Richardvatn (505), Svalbard, Norway (0-1)	10.0	0.42	44.1	194	111	0.083	54.3	38.2	0.87	183
Asovatn (506), Svalbard, Norway (0-1)	10.2	3.30	8.86	23.0	41.2	0.200	15.1	37.7	3.39	168

104

Table 15

Content of Metals in Fish samples, mg/kg wet weight

Sample ID:	As	Cd	Co	Cr	Cu	Hg	Ni	Pb	Se	Zn
Valnesvatn (210), Nordland, Norway, Fish Valnes	0.27	0.003	0.011	0.061	0.42	0.154	0.018	0.015	0.68	9.76
Langvatn (257), Finnmark, Norway, Fish Langvatn	0.45	0.003	0.018	0.044	0.32	0.066	<0.010	0.016	1.07	4.36
Ellasjoen (401), Svalbard, Norway, Fish Ellasjoen	0.28	0.004	0.070	0.045	0.37	0.078	<0.010	0.020	1.57	6.57
Oyangen (402) Svalbard, Norway, Fish Oyangen	0.28	0.001	0.016	0.055	0.66	0.041	<0.010	0.015	1.25	5.57
Richardvatn (505), Svalbard, Norway, Fish Richardvatn	0.27	0.001	0.058	0.042	0.82	0.058	<0.010	0.017	2.17	8.14
Asovatn (506), Svalbard, Norway, Fish Asovatn	0.29	0.002	0.034	0.051	0.38	0.194	<0.010	0.020	1.81	6.73
Holmevatn (323), Troms, Norway, Fish Holmevatn	0.27	0.002	0.011	0.029	0.60	0.026	<0.010	0.016	1.43	6.72
Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri	0.38	0.001	0.011	0.028	0.78	0.220	<0.010	0.024	0.38	4.67
Gavdnajavri (282), Finnmark, Norway, Fish Gavdjejavri D	0.46	0.001	0.011	0.025	0.71	0.211	<0.010	0.020	0.42	4.68
Richardvatn (505), Svalbard, Norway, R1	-	-	-	-	-	0.083	-	-	-	-
Richardvatn (505), Svalbard, Norway, R2	-	-	-	-	-	0.053	-	-	-	-
Richardvatn (505), Svalbard, Norway, R4	-	-	-	-	-	0.140	-	-	-	-
Richardvatn (505), Svalbard, Norway, R5	-	-	-	-	-	0.049	-	-	-	-
Richardvatn (505), Svalbard, Norway, R6	-	-	-	-	-	0.064	-	-	-	-
Asovatn (506), Svalbard, Norway, A9	-	-	-	-	-	0.374	-	-	-	-
Asovatn (506), Svalbard, Norway, A10	-	-	-	-	-	0.290	-	-	-	-
Asovatn (506), Svalbard, Norway, A11	-	-	-	-	-	0.313	-	-	-	-
Asovatn (506), Svalbard, Norway, A12	-	-	-	-	-	0.190	-	-	-	-
Asovatn (506), Svalbard, Norway, A13	-	-	-	-	-	0.119	-	-	-	-

Statlig program for forurensningsovervåking
Overvåking av langtransportert luft og nedbør

Statens forurensningstilsyn (SFT)
Postboks 8100 Dep, 0032 Oslo - Besøksadresse: Strømsveien 96
Telefon: 22 57 34 00 - Telefaks: 22 67 67 06
E-post: postmottak@sft.no - Internett: www.sft.no

Utførende institusjon	ISBN-nummer
Akvaplan-niva, Norsk institutt for vannforskning	978-82-577-5284-9

Oppdragstakers prosjektansvarlig	Kontaktperson SFT	TA-nummer
Guttorm N. Christensen	Tor Johannessen	2363-2008

	År	Sidetall	SFTs kontraktnummer
	2008	170	5007088

Utgiver	Prosjektet er finansiert av
Norsk institutt for vannforskning (NIVA)	Statens forurensningstilsyn, med delfinansiering fra NIVA og Statoil ASA (feltarbeid i Nord-Norge)

Forfatter(e)

Guttorm N. Christensen, Akvaplan-niva, Anita Evenset, Akvaplan-niva, Sigurd Rognerud, NIVA, Brit Lisa Skjelkvåle, NIVA, Rune Palerud, Akvaplan-niva, Eirik Fjeld, NIVA, Oddvar Røyset, NIVA

Tittel - norsk og engelsk

Nasjonal innsjøundersøkelse 2004 - 2006, DEL III: AMAP. Status for metaller og miljøgifter i innsjøer og fisk i den norske del av AMAP regionen.

National lake survey 2004 - 2006, PART III: AMAP. Status of metals and environmental pollutants in lakes and fish from the Norwegian part of the AMAP region.

Sammendrag - summary

Denne rapporten inneholder resultater fra innsjøundersøkelser i den norske delen av AMAP regionen som omfatter; Nordland, Troms, Finnmark og Svalbard. Totalt er 123 innsjøer undersøkt. I 122 av innsjøene er metallnivåene i sediment undersøkt. Videre er 75 innsjøer undersøkt for PAH, 55 for PCB og 42 for andre persistente organiske miljøgifter (PBDE, pesticider, osv). Innholdet av miljøgifter i fisk ble undersøkt i 8 innsjøer.
This report contain results from lake invettigations in the Norwegian part of the AMAP region; Nordland, Troms and Finnmark Counties and Svalbard. A total of 123 lakes were included in the study. In 122 lakes the sediments were analysed for metals. Further 75 lakes were studied for PAH, 55 lakes for PCB and 42 lakes for other persistent organic pollutants (PBDE, pesticides, etc). Contaminants in fish were studied in 8 lakes.

4 emneord	4 subject words
AMAP	AMAP
Miljøgifter	Contaminants
Innsjø sedimenter	Lake sediments
Fisk	Fish

Statens forurensningstilsyn
Postboks 8100 Dep,
NO 0032 Oslo
Besøksadresse: Strømsveien 96

Telefon: 22 57 34 00
Telefaks: 22 67 67 06
E-post: postmottak@sft.no
Bestilling: www.sft.no/skjema.html