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## Organochlorines in sediments and biota from Greenland

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### Abstract

484 samples of sediments and biota, representing mussels, fish, birds and seals from Greenland were collected in 1994 and 1995 at four different locations in Greenland, three at the west coast and one at the east coast. The analyses performed included PCBs, HCB, HCHs, Dieldrin, DDTs, chlordanes, toxaphenes and PAHs, determined in all samples or in a part of them. The results showed levels comparable or slightly lower than values reported from other Arctic regions. For all species analyzed PCB and DDT levels were found higher at the east coast compared to the west coast of Greenland. Organochlorines were found to concentrate in animals of higher trophic levels to different degrees, while PAHs showed the highest levels in shorthorn sculpin, the lowest in seal blubber.

### Introduction

The present work is a part of the Danish-Greenland Arctic Monitoring and Assessment Programme (AMAP), which further form a part of the international AMAP programme initiated by the Ministerial Meeting in June 1991 in Rovaniemi, Finland. The Danish-Greenland AMAP includes in addition to the work described in the present paper, investigations on levels of heavy metals, radioactivity, acidification, Arctic haze and human health (AMAP, Greenland 1994-1996<sup>1)</sup>).

### Experimental Methods

#### Sampling

The National Environmental Research Institute, Department of Arctic Environment sampled during the summers of 1994 and 1995 sediments, landlocked Arctic char (*Salvelinus alpinus*), blue mussels (*Mytilus edulis*), shorthorn sculpins (*Myoxocephalus scorpius*), polar cods (*Boreogadus saida*), glaucous gulls (*Larus hyperboreus*) and ringed seals (*Phoca hispida*). The locations of sampling were Avanersuaq/Thule at the north west coast, Qeqertarsuaq/Disko at the west coast, Nanortalik at the south west coast and Ittoqortoormiit/Scoresbysund at the east coast of Greenland.

# LEVELS IN FOOD

## Analyses

The National Environmental Research Institute, Department of Environmental Chemistry carried out the main part of the analyses of organochlorines in marine biota determined by GC/ECD and PAHs in sediments and biota by GC/MS. Further, the Institute of Marine Research, Bergen, made the analyses of organochlorines in sediments using GC/ECD and RIVO-DLO, IJmiuden, analyzed organochlorines in arctic char by GC/ECD or GC/MS (NCI) as well as toxaphenes in seal blubber by GC/MS (NCI).

The three laboratories assured interlaboratory quality control and participated in the QUASIMEME intercomparison exercises simultaneously with the analyses of the Greenland samples. The laboratories were selected as reference laboratories in the QUASIMEME laboratory testing scheme and their results can be regarded as highly comparable according to the QUASIMEME reports <sup>2)</sup>.

## Results and Discussion

### Overview

An overview of the geometric mean values for all matrices and all sampling sites in Greenland is given in Table 1. The individual ranges of the values, not given in the table, are typically significant. Thus, the measurements of the sum of DDTs in blubber of ringed seals ranged from 97 to 6040 µg/kg wet weight, the geometric mean value being 607 µg/kg wet weight.

**Table 1**

Geometric mean values of persistent organic pollutants in Greenland sediments (µg/kg dry weight) and biota (µg/kg wet weight) for all sampling areas.

Compounds Matrix	No. samples (Orgchl)	PCBs 1)	HCB 2)	HCHs 3)	Dieldr 4)	DDTs 5)	trans-nonachlor	Toxaphenes 6)	No. samples (PAHs)	PAHs 7)
Landlocked Arctic char, muscle	100	11	0.7	0.4	0.7	4.0	2,3	13	-	-
Lake sediments	4	<1	<0.1	<0.3	<0.1	<0.3	<0.1	-	-	-
Sea sediments	20	<1	- 8)	<0.3	-	<0.3	-	-	20	278
Blue mussel, soft tissue	44	0.86	0.06	0.56	-	0.39	0.16	-	10	65
Shorthorn sculpin, liver	100	17	4.2	8.7	-	11	6.3	-	10	839
Polar cod, liver	16	33	11	32	-	36	19	-	-	-
Glaucous gull, liver	100	422	50	8.6	-	389	18	-	-	-
Ringed seal, blubber	100	452	13	123	-	607	83	263 (n=56)	10	97

1) PCBs: sum of CB-28, CB-31, CB-52, CB-101, CB-105, CB-118, CB-138(+163), CB-153, CB-156 and CB-180

2) HCB: hexachlorobenzene

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- 3) HCHs: sum of hexachlorocyclohexanes: alpha-HCH, beta-HCH and gamma-HCH (lindane)
- 4) Dieldrin: dieldrine
- 5) DDTs: sum of pp'-DDT, pp'-DDD and pp'-DDE
- 6) Toxaphenes: total toxaphene analyzed as a technical mixture of toxaphenes  
Four single congeners were further analyzed, but not given in this table.
- 7) PAHs: sum of naphthalene, methyl naphthalenes, dimethyl naphthalenes, trimethyl naphthalenes, anthracene, phenanthrene, methyl phenanthrenes, dimethyl phenanthrenes, trimethyl phenanthrenes, dibenzothiophene, methyl dibenzothiophenes, flouranthene, pyrene, benzo(a)anthracene, triphenylene/chrysene, benzo(b+j+k)flouranthene, benzo(e)pyrene, benzo(a)pyrene, perylene, indeno(1,2,3-cd)pyrene, benzo(ghi)perylene, dibenzo(a,h)anthracene
- 8) - : not analyzed

All samples were collected in equal numbers at the four locations. The only exceptions were mussels which were not found in Avanersuaq/Thule and Ittoqqortoormiit/Scoresbysund and polar cods which were available mainly as small individuals in Avanersuaq/Thule and Ittoqqortoormiit/Scoresbysund. Further, PAHs were analyzed in blue mussels, shorthorn sculpins and ringed seals from Qeqertarsuaq/ Disko only.

## *Geographical trends of organochlorines*

Sculpins, seals and landlocked Arctic char showed the same pattern for PCBs and DDTs, the concentration levels being significantly the highest in Ittoqqortoormiit/ Scoresbysund at the east coast and significantly lowest in Qeqertarsuaq/Disko or Avanersuaq/Thule. PCB and DDT concentrations in gulls showed the same tendency, without proving any statistical significant differences. Thus, all species analyzed at four areas of Greenland exhibit a decreasing PCB and DDT trend following the ocean current flowing from north to south of the east coast and towards north of the west coast of Greenland.

The pattern of HCHs is more confusing. For marine species it virtually mimics the pattern of PCB and DDT, as the HCH concentrations in sculpins were significantly the highest at the east coast compared to the west coast, HCHs in gulls were the lowest in Nanortalik and Qeqertarsuaq/Disko. On the other hand, HCHs in seals showed no geographical differences at all. However, HCH levels in landlocked Arctic char were significantly the highest in Nuuk/Godthaab at the southern part of the west coast. Thus, an explanation for this somewhat confusing pattern may well be a combination of several sources, e.g. one coming from North-East by the ocean current and wind, and another coming from West or South-West by the wind only.

HCB and trans-nonachlor show no clear geographical trends. However, there may be a tendency to see the highest concentrations at the east coast and/or at the north west coast.

Toxaphene was measured in all landlocked Arctic chars and approximately half of the seals investigated. The char showed significantly the highest levels at the east coast compared to all areas of the west coast, whereas the seals displayed no significant geographical differences.

# LEVELS IN FOOD

## *Concentrations at different trophic levels*

Considering the geometric mean values of the marine animals of Table 1, it is obvious that the different compounds concentrate in animals of higher trophic levels to various degrees, thus demonstrating the different ability of the species to metabolize the compounds concerned. For the two species at the lowest trophic levels, i.e. mussels and sculpins, a relatively even distribution of the organochlorine compounds is seen, levels being higher in sculpins than in mussels. At higher trophic levels very different patterns are developed. For PCBs, DDTs and to a smaller extent for trans-nonachlor a tendency towards higher concentrations are seen in both glaucous gulls and ringed seals. However, HCHs occur in glaucous gulls in relative low concentrations compared to PCBs and DDTs, whereas HCB concentration levels are relatively low in ringed seal blubber.

PAHs occur in sculpin livers in unexpectedly high concentrations, even higher than found in sediment samples. This may be caused by the benthic and scavenger behavior of the shorthorn sculpin combined with a disability to metabolize PAHs.

## *Greenland compared to other countries*

The concentrations of organochlorines and PAHs found in the Greenland fauna showed levels in agreement with data published from other Arctic regions, however, typically in the lower end or in the middle of the ranges reported. Compared to levels found in animals from more southern regions the Greenland fauna is generally low contaminated.

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## **Literature Cited**

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