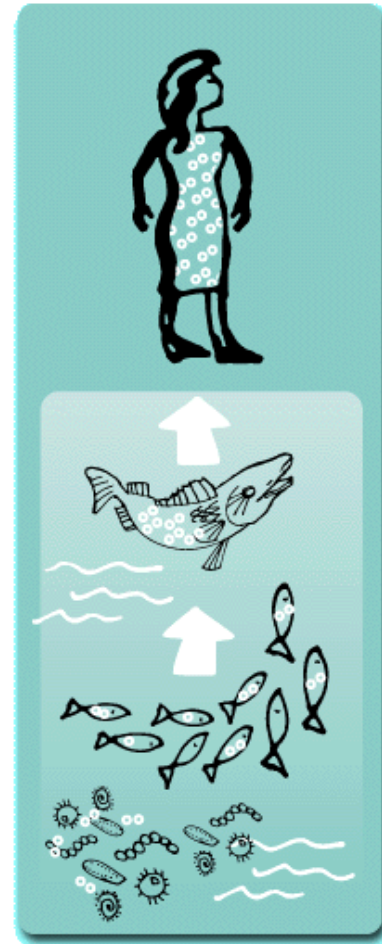


# ***CONTAMINANTS***

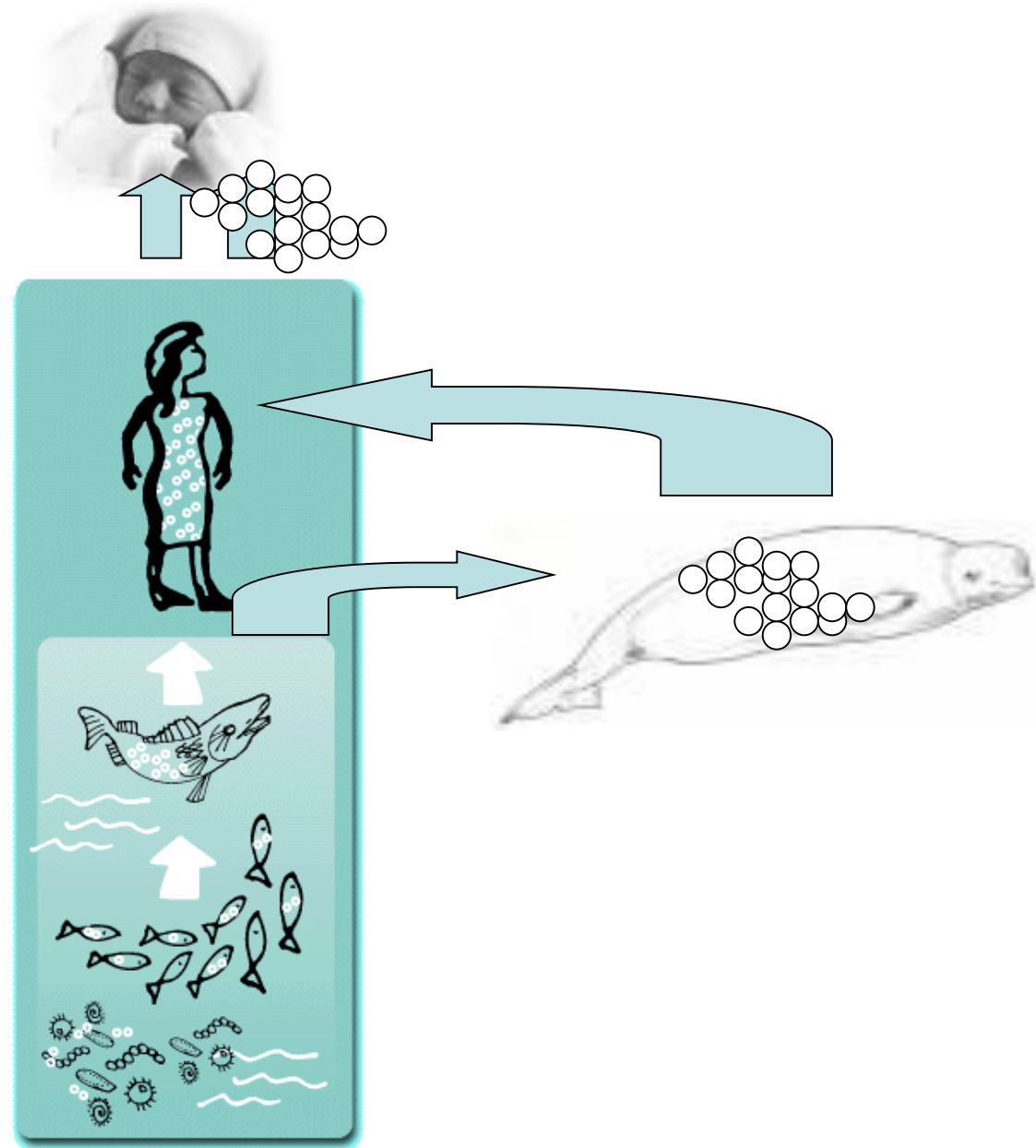


# Transfer of OC from mother to newborn through milk



Milk: 4.5 % lipid

# INUIT



# Transfer of OC from mother to newborn through milk

0031-3998/01/5003-0331  
PEDIATRIC RESEARCH  
Copyright © 2001 International Pediatric Research Foundation, Inc.

Vol. 50, No. 3, 2001  
Printed in U.S.A.

## Early Childhood Determinants of Organochlorine Concentrations in School-Aged Children

WILFRIED KARMAUS, E. PAUL DeKONING, HERMANN KRUSE, JUTTA WITTEN, AND  
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Hamburg, Germany [N.O.]*

Environmental Research Section A 80, S166–S174 (1999)

Article ID enrs.1998.3939, available online at <http://www.idealibrary.com> on IDEAL®

## Relation of Lake Ontario Fish Consumption, Lifetime Lactation, and Parity to Breast Milk Polychlorobiphenyl and Pesticide Concentrations

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University at Buffalo, Buffalo, New York 14214*

Received December 22, 1997

Children's Health | Article

## Assessment of Pre- and Postnatal Exposure to Polychlorinated Biphenyls: Lessons from the Inuit Cohort Study

Pierre Ayotte,<sup>1</sup> Gina Muckle,<sup>1</sup> Joseph L. Jacobson,<sup>2</sup> Sandra W. Jacobson,<sup>3</sup> and Eric Dewailly<sup>1</sup>

<sup>1</sup>Department of Social and Preventive Medicine, Laval University and Public Health Research Unit, CHUQ-Laval University Medical Centre, Québec, Québec, Canada; <sup>2</sup>Department of Psychology, Wayne State University, Detroit, Michigan, USA; <sup>3</sup>Department of Psychiatry and Behavioral Neurosciences, Wayne State University School of Medicine, Detroit, Michigan, USA

# PCBs

St Lawrence



Arctic



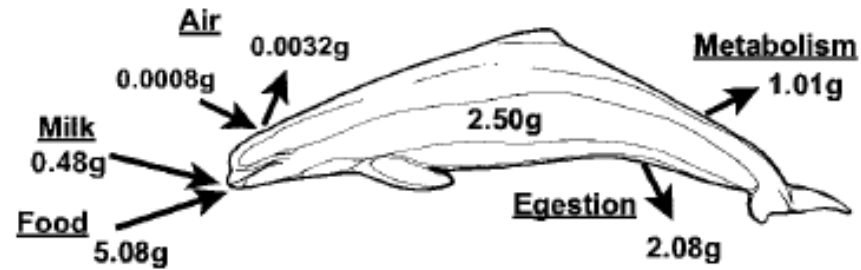
➤➤  
(10-50 x)

PCBs congeners more chlorinated

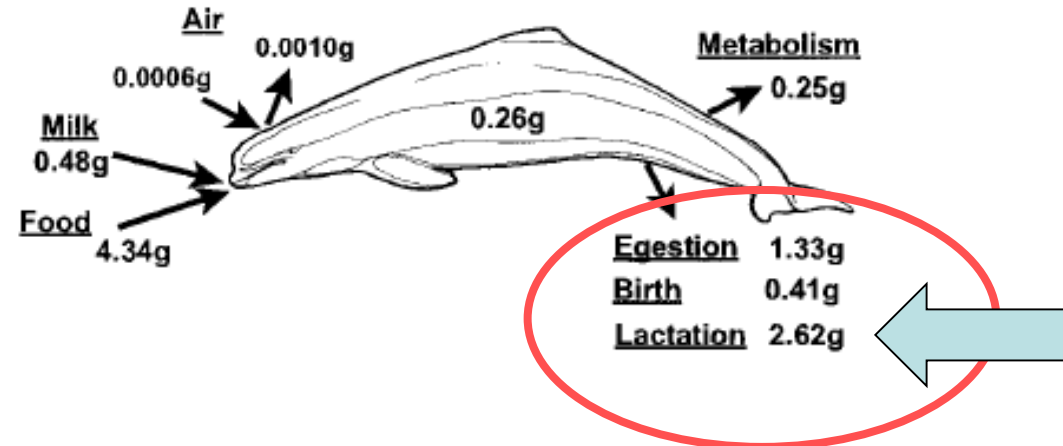
PCB mass balance for male and female beluga. West Greenland.

Hickie et al 1999

**Male**

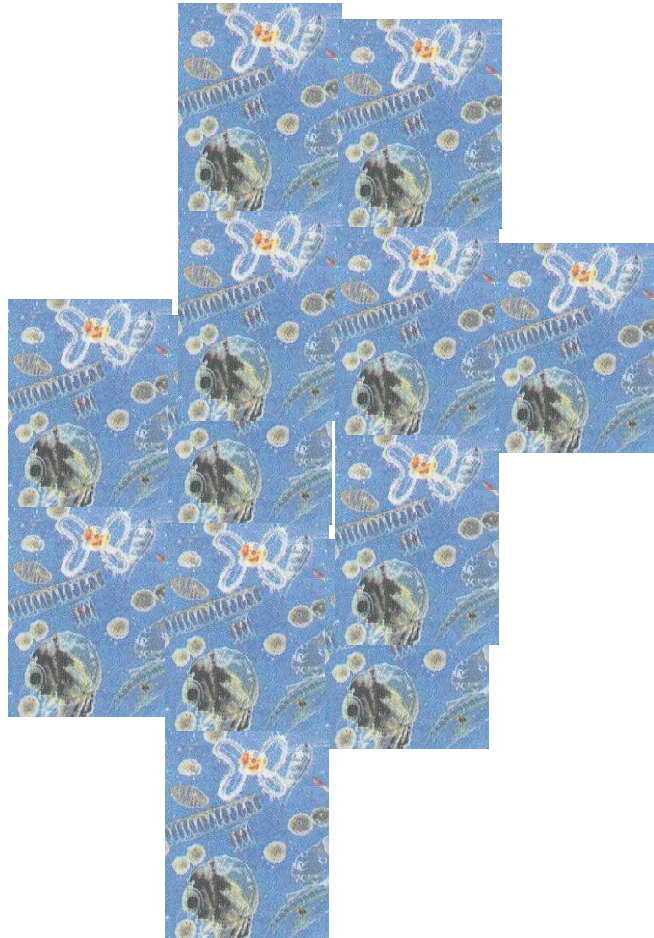


**Female**



# PCBs, CYP and hormones

PCB



PCB

PCB → CYP ↑



Capelin (*Mallotus villosus*): 16-18 cm  
(female above)



Capelin (*Mallotus villosus*): 16-18 cm  
(female above)





# Contamination by butyltins



## France

- 1975: France: problems with oyster reproduction
- 1980s: Arcachon Bay, linked to tributyltin
- 1982: France bans TBT-containing antifouling paints except that ...



# Contamination by butyltins



Allowed



Not allowed...

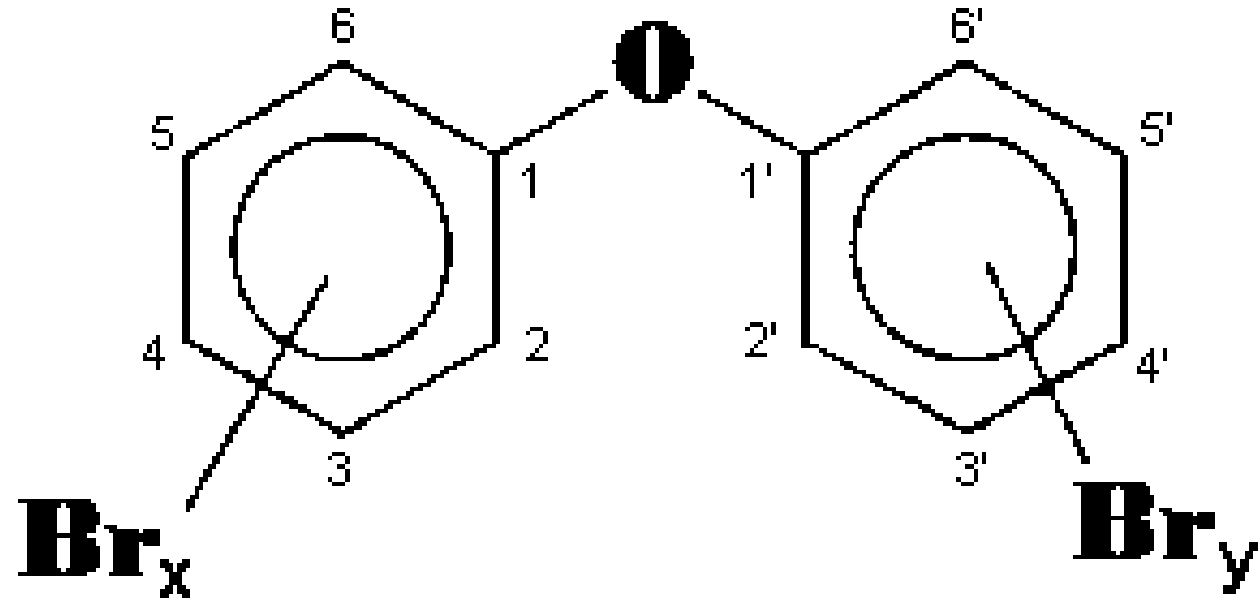


Boats < 25 m !!

# PBDE. St Lawrence beluga

- 1988 to 1999: Concentrations doubled:
  - Males: every 3 years
  - Females: every 2 years

# Polybrominated diphenylethers (« PBDE »)



Additive flame retardants

# PBDE

Do flame retardants threaten ocean life?

Brominated flame retardants are important in modern life. They are used at relatively high concentrations in electronic equipment such as computers and television sets, in textiles, cars and in many other applications. Here we show that two groups of these flame retardants, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs), are present in sperm whales, which normally stay and feed in deep water, indicating that these compounds have reached deep ocean waters.

« Here we show that PBDE are present in sperm whales.. indicating that these compounds have reached deep ocean waters »

- De Boer et al, Nature 394:28 (1998)



Polychlorinated biphenyls and bromodiphenyl ethers in marine wildlife samples

PBB† concentrations (µg per kg wet weight)								PBDE† concentrations (µg per kg wet weight)			
15	49	52	101	153	189	209	47	xy‡	99	209	
0.06	0.24	0.40	0.91	1.9	<0.1	<0.5	95	15	26	<6	
0.04	0.13	0.21	0.40	0.73	0.05	<0.3	58	8.1	15	<3	
0.07	0.20	0.36	0.70	1.1	<0.1	<0.4	61	7.5	10	<5	
<0.01	<0.01	<0.01	0.63	18	<0.04	<0.3	2.7	0.54	0.91	<3	
0.2	7.5	4.1	8.3	13	<0.2	<0.9	5,500	1,200	1,000	<10	
<0.01	0.06	0.03	0.74	19	<0.02	<0.1	22	5.8	3.0	<1	
0.11	0.27	0.24	0.54	0.82	<0.02	<0.1	88	11	23	<1	
<0.05	34	5.7	9.3	61	12	<1	1,200	110	160	<15	
<0.05	3.1	2.3	1.4	18	<0.2	<1	1,200	100	40	<10	
<0.05	3.0	0.52	1.1	13	<0.1	<1	280	18	140	<10	
<0.01	0.10	0.05	0.62	1.5	<0.02	<0.1	21	0.93	0.85	<2	
<0.01	0.10	0.03	0.04	0.82	<0.01	<0.1	12	0.33	5.1	<1	
<0.01	0.90	0.14	0.44	13	<0.02	<0.1	20	0.07	0.53	<2	
0.01	0.01	0.01	<0.01	0.04	<0.03	<0.2	5.4	1.8	1.9	<2	

except for seal 1 blubber and seal 3 blubber and liver, for which extractable lipid contents are shown.

† according to the PCB numbering system of ref. 12.

‡ xy-PBDE is pentabrominated BDE with unknown structure.





Before



After

Thursday, 29 January, 2004, 16:45 GMT

## **Whale explodes in Taiwanese city**

A dead sperm whale has exploded while being delivered to a research centre near the southwestern city of Tainan

# PBDE. St Lawrence beluga

- 1988 to 1999: Concentrations doubled:
  - Males: every 3 years
  - Females: every 2 years



# Perfluorinated Hydrocarbons

Carbon chain ornated with fluor atoms.

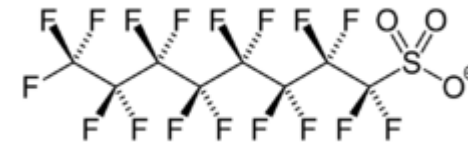
Fluor remains electronegative because its electrons are not distributed in a aromatic ring

`-> less hydrophobic than PCBs. Hydrophobic AND hydrophilic

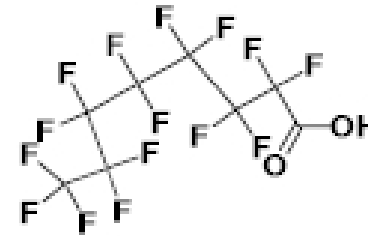
-> bind other electron-poor molecules (= proteins)

All derive from perfluoroalkyl acids

- **Perfluorooctane sulfonate (PFOS)**

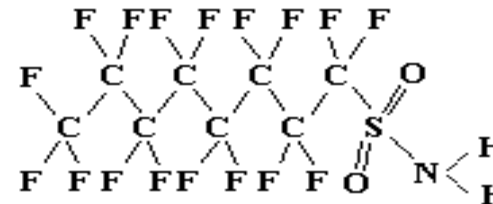


- Perfluorooctanoic acid (PFOA)



- Perfluorodecanoic acid (PFDA)

- Perfluorooctanesulfoamide (PFOSA)

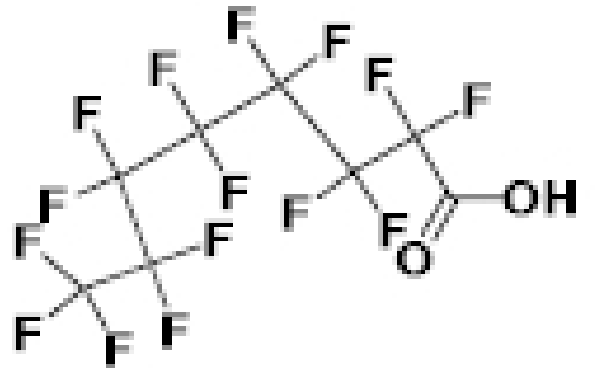


Stable, good absorption, very slow elimination



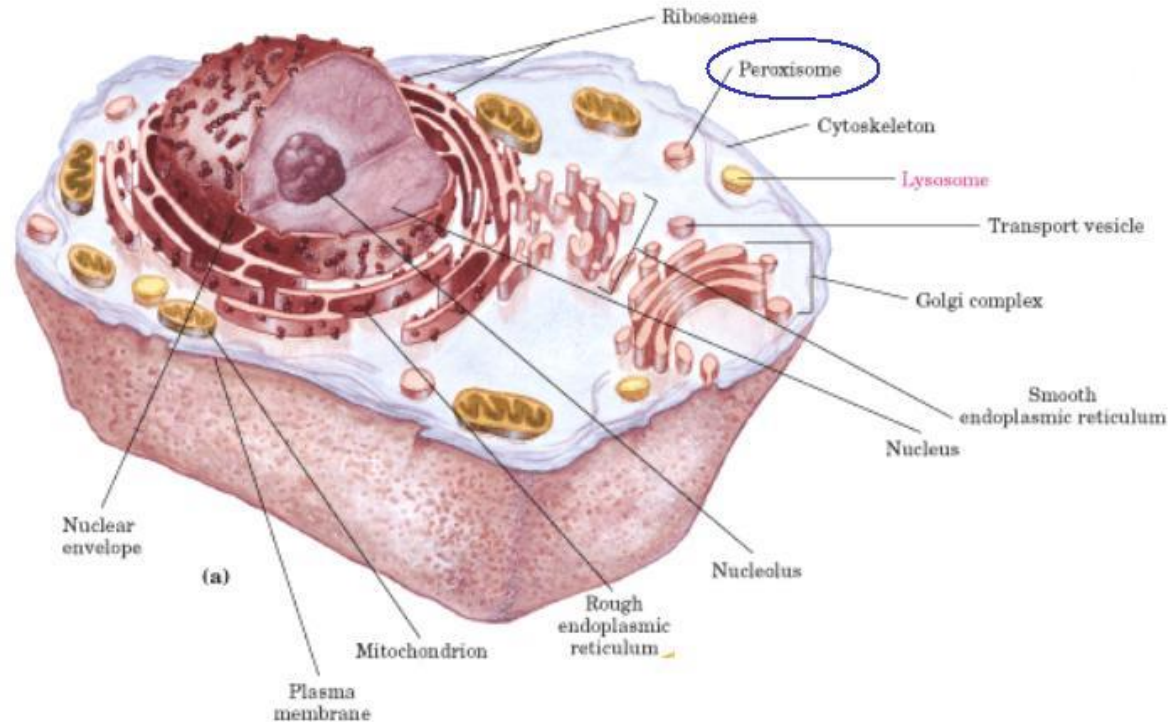
# Perfluorooctanoic acid (PFOA)

- Target: liver
    - cause peroxysomes proliferation : « PPAR agonists »
    - interfere with fatty acid metabolism
    - ↓ cholesterol synthesis (like statins)
- (Kennedy et coll 2004)



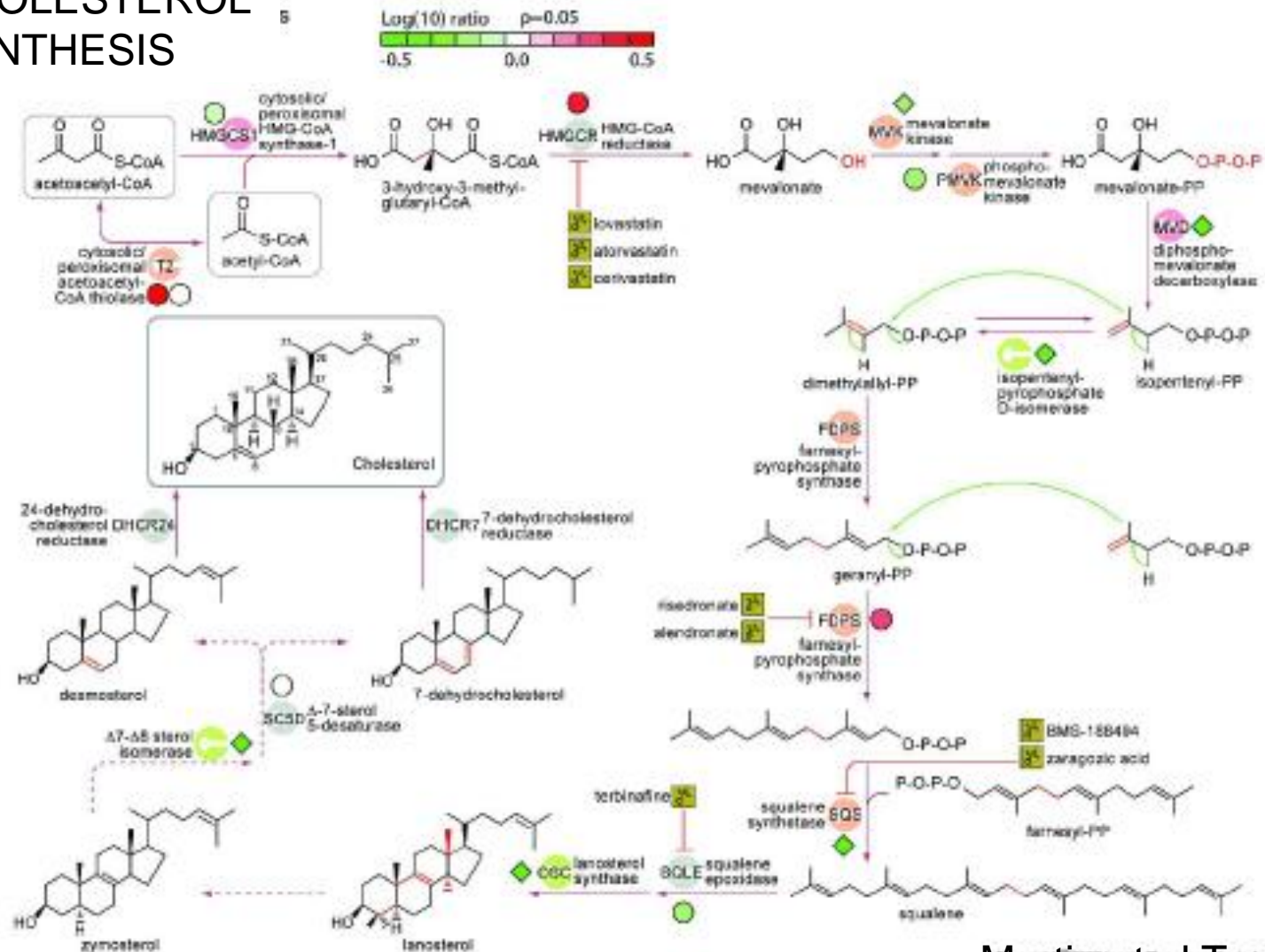
**PFOA**  
(Perfluorooctanoic acid)

## Animal cell peroxisomes



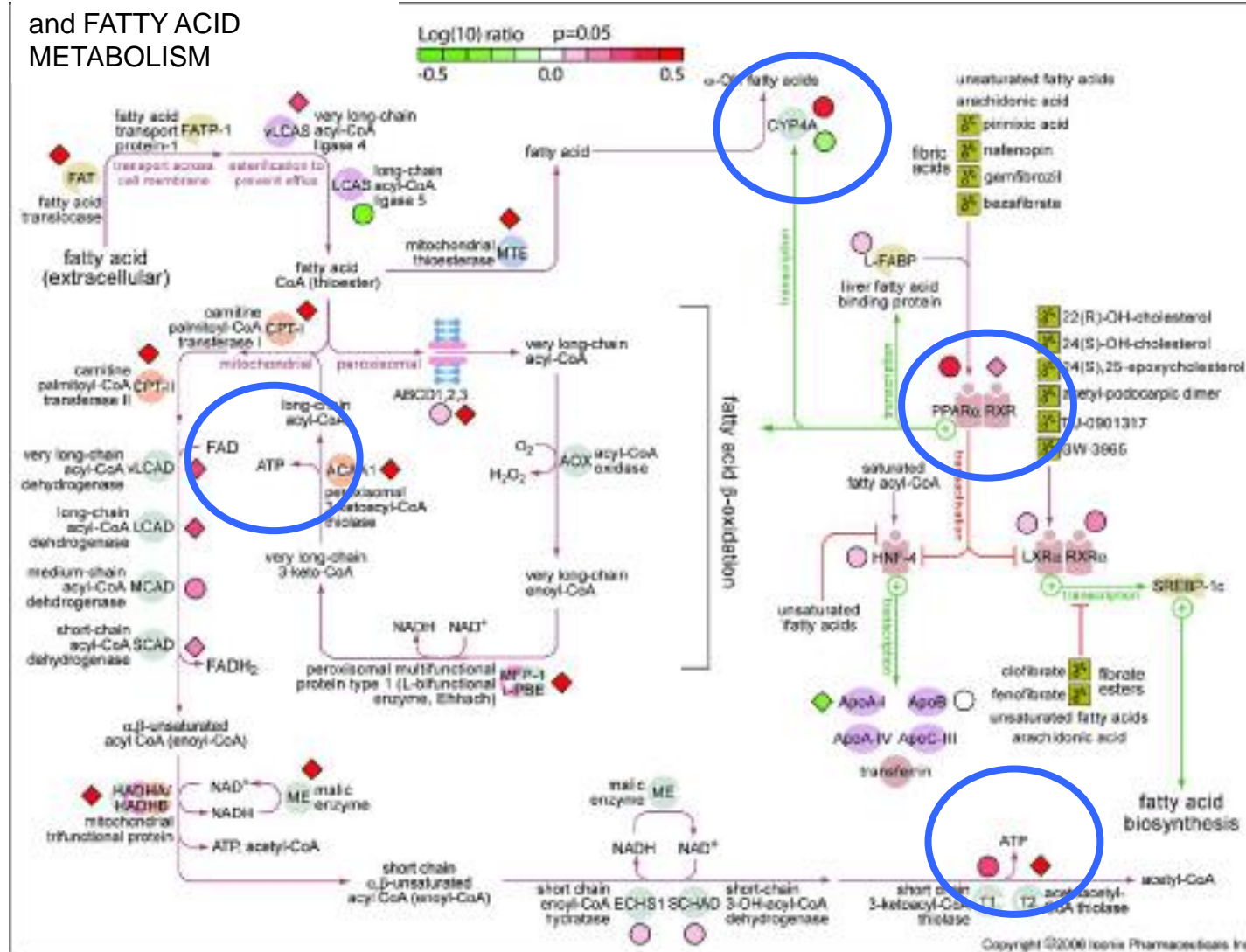
# PFOA. Day 3

## CHOLESTEROL SYNTHESIS

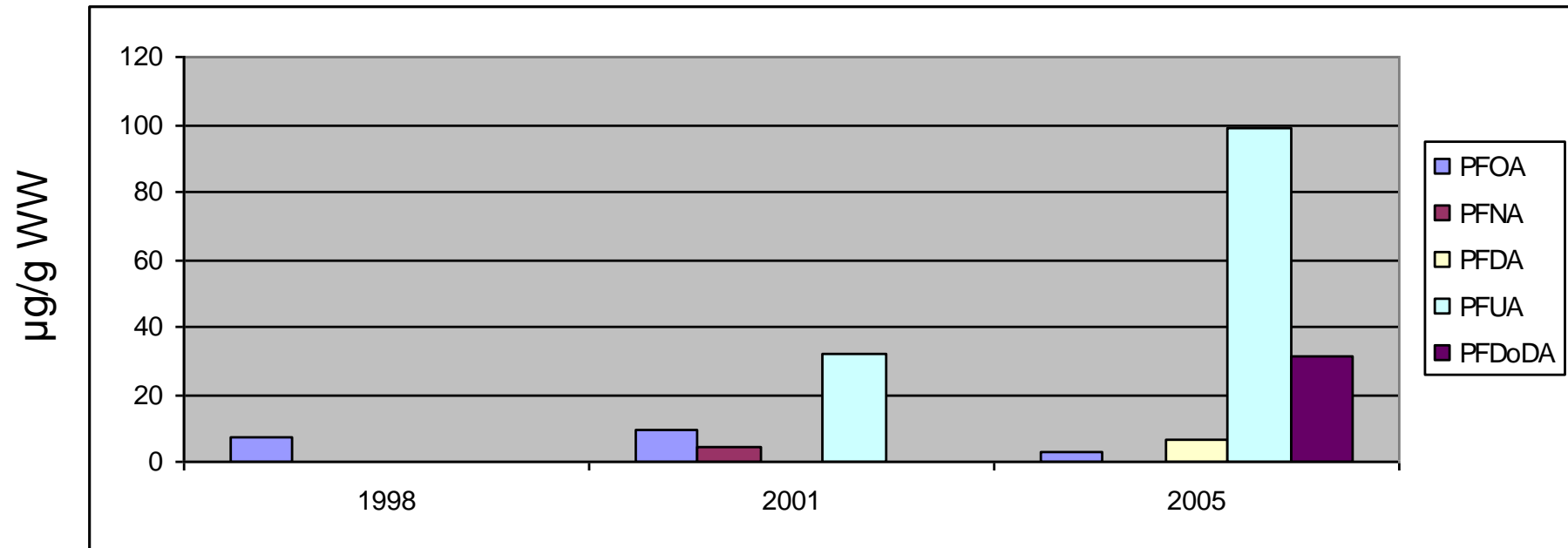


# PFOA. Day 5.

PPAR  
and FATTY ACID  
METABOLISM



# Perfluorinated compounds. St Lawrence beluga



Lebeuf, M et Tomy G., MPO, preliminary data

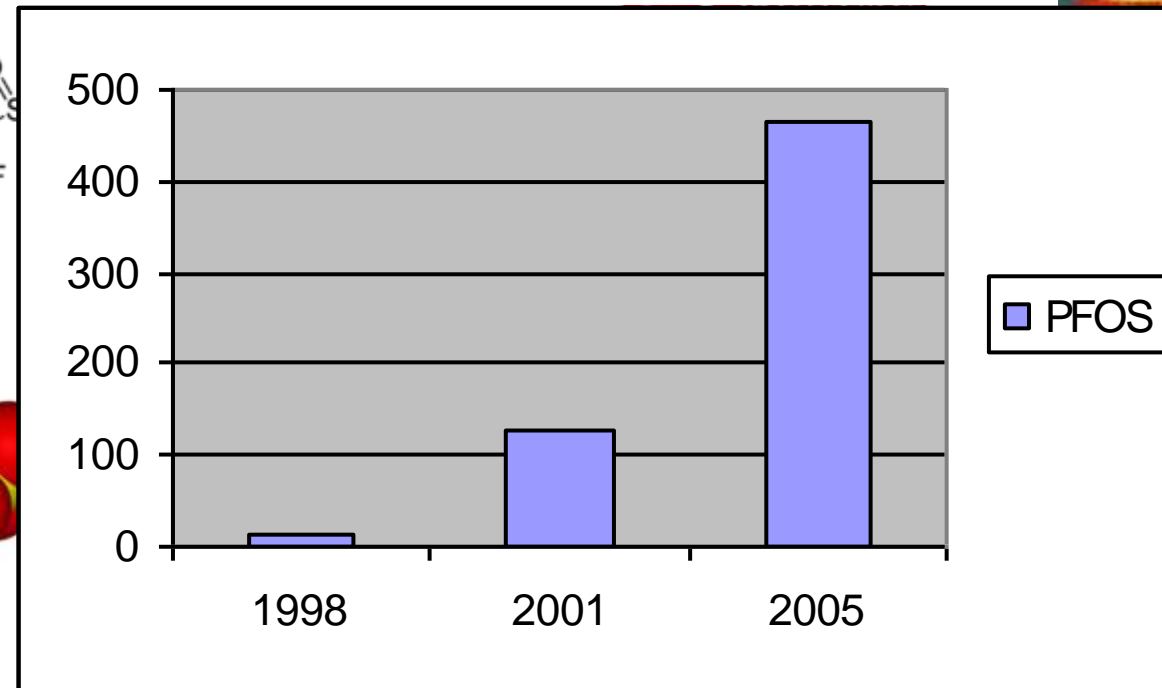
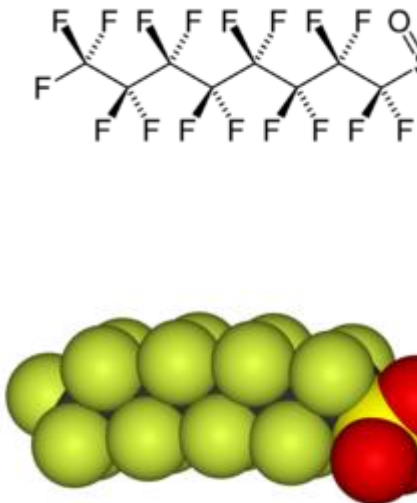


# Perfluorooctane sulfonate (PFOS)

- « Scotchgard », by 3M
- « stain repellent »



St Lawrence beluga whales



May 2000: 3M stops fabrication

# Perfluoroalkyl compounds (PFAS)

## Emissions, discharges, distribution and hot-spots

Emissions in Norway in 2002 are estimated to 13 - 15 tons, but these estimates are very rough. PFAS may have been used in specific paper productions. The compound Cera-F may form perfluoroalkyl compounds. Cera F is used widely in ski waxes (glider and wax). Possible hotspots are start areas / ski preparation areas of ski tracks.

A study of the priority substances  
of the Water Framework Directive

*Monitoring and need for screening*

TA-2140/2005



Bergfald & Co as

## Conclusions

- PFOA, PBDE: new stable molecules massively produced and released worldwide into the environment with little knowledge on toxicity  
... not a good idea ?
  - Knowledge on the toxicity of these new molecules: same as for PCBs in the 80s

# Conclusions

Metabolites of PCBs (« classic »)  
and newer contaminants (PBDE, PFOA)  
= new family of toxic compounds

# Future research

## 1) Biomarkers:

PAH adducts in fish

PAH adducts in wild animals (woodchucks)

PAH metabolites in urine, of animals, of people,  
of aluminum workers (??!!)

## 2) Molecular epidemiology of cancer

Nucleotide sequence of the p53 cDNA of beluga whale

## 3) Transgenic mice

cDNA Cloning and Characterization of a High Affinity Aryl Hydrocarbon Receptor  
in a Cetacean, the Beluga, *Delphinapterus leucas*

- BA Jensen and ME Hahn. Toxicol Sci. 2001 64(1):41-56

- Xu N, Shiraki et al. Gene 2002 288(1-2):159-166

# Future research

- 4) Microarrays to measure gene expression:**
  - Toxicogenomics**
  - Stress genes**