

Organophosphate Ester Flame Retardants and Plasticizers in the Canadian Arctic

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Introduction

Persistent Organic Pollutants are transported to the Arctic by air and ocean currents.

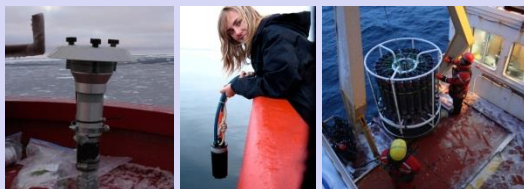
Sampling in the Canadian Archipelago has been done at land based stations and on cruises aboard Canadian Coast Guard ships (Louis S. St. Laurent and Amundsen). These studies have been conducted by the same team since 2007.

Compounds of interest are organophosphate ester flame retardants and plasticizers.

Rationale

This work supports the Canadian Chemical Management Plan, Northern Contaminants Program, and Canadian Environmental Protection Act (CEPA) 1999.

Sampling Techniques



air sampler
submersible water sampler
rosette water sampler

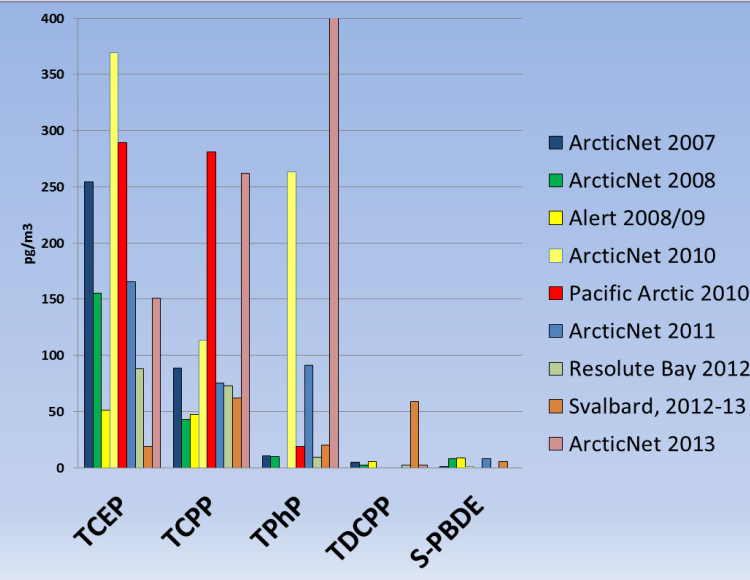
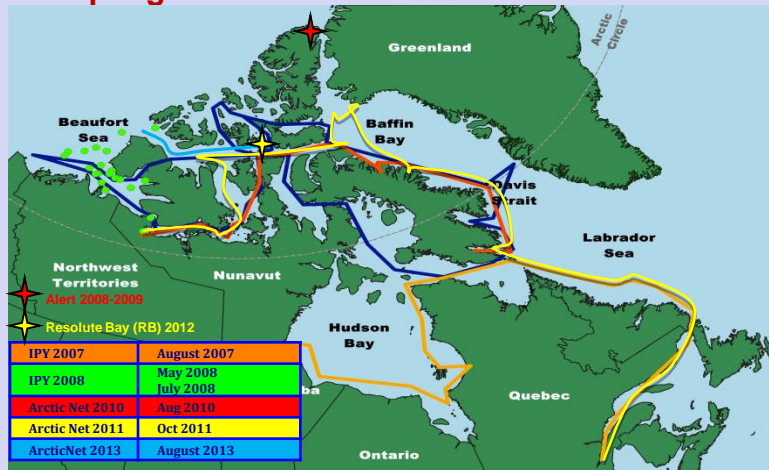
Target Compounds: OPEs

- Tri-phenyl phosphate (TPHP)
- Tris(chloro-propyl) phosphate (TCPP)
- Tris(chloro-ethyl) phosphate (TCEP)
- Tris(dichloro-propyl) phosphate (TDCPP)
- Ethylhexyl diphenyl phosphate (EHDPP)
- Tri-butyl Phosphate (TBP)

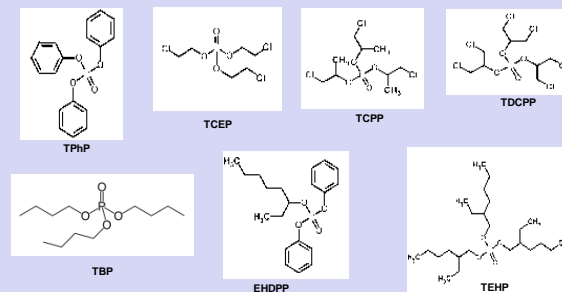
Materials and Methods

- Water: 40-100 L were processed through a glass-fiber filter followed by XAD-2 resin, OPEs are mainly in the dissolved phase.
- Air: 400-1500 m³ were sampled with a glass fiber filter - PUF/XAD cartridge, OPEs are in the particulate phase.
- OPEs were determined by capillary GC using a DB-5 column, with detection by ECNI-MS and EI-MS modes.
- Labelled surrogates (¹³C and deuterated) were added to each sample to monitor recoveries (range from 67-109%).

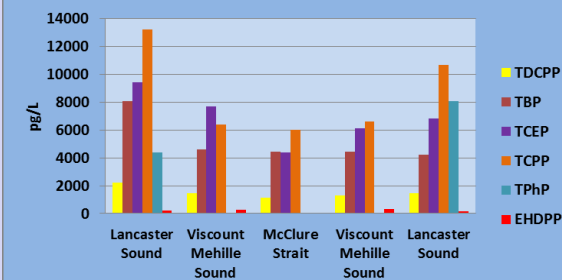
Sampling Locations and Cruise Tracks



Average concentrations of OPEs in the Canadian Arctic air: ArcticNet 2007: shipboard August in the Labrador Sea and Hudson Bay; ArcticNet 2008: shipboard May-June in the Beaufort Sea; Alert 2008/09: land based Dec 2008 to Aug 2009 (blank problems for TPhP); Pacific Arctic 2010: ship based Bering-Chukchi-Beaufort Seas summer of 2010 (Moller et al., 2012); ArcticNet 2011: October shipboard central and east archipelago; Resolute Bay: land based July 2012, Svalbard 2012/13 (Salamova et al., 2014) and ArcticNet 2013: ship board in Barrow Strait and McClure Strait. Compared to the sum-PBDEs in Greenland, Ny Alesund and the Alert monitoring station (Su et al., 2007).



OPEs in Arctic Water



Concentration of OPEs in Canadian Archipelago water from Resolute Bay West to the Beaufort Sea in 2013.

Results and Discussion

- OPEs are flame retardants and plasticizers but are also used in hydraulic fluids and levelers in floor waxes.
- Most are Canadian Chemical Management Plan priority compounds, TCEP has been phased out in Europe and is being phased out in Canada due to toxicity.
- OPEs are high in indoor air (up to 1000s pg/m³) and dust (up to 10000s ng/g) (van der Veen and deBoer, 2012).
- OPEs were found only on air particles.
- Very high levels of OPEs were found compared to levels of other flame retardants; i.e. Σ PBDEs (Su et al., 2007).
- Similar levels of OPEs were found in air over the North Sea and the Bering and Chukchi Seas (Moller et al., 2011, 2012).

References:

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