

Global distribution of organic micropollutants in marine plastics

Shige TAKADA,
Laboratory of Organic Geochemistry
(LOG), Tokyo University of Agric. &
Technol.

Acknowledgement

TUAT LOG : Hisashi Hirai, Yuko Ogata, Kaoruko Mizukawa, Rei Yamashita,

Hokkaido Univ. : Yutaka Watanuki, Daisuke Ochi

Algalita Marine Research Foundation : Charles Moore, Holly Gray, Duane Laursen

SEA Education Association : Erik R. Zettler,

Woods Hole Oceanographic Institution : John W.Farrington, Christopher M. Reddy, Emily Peacock

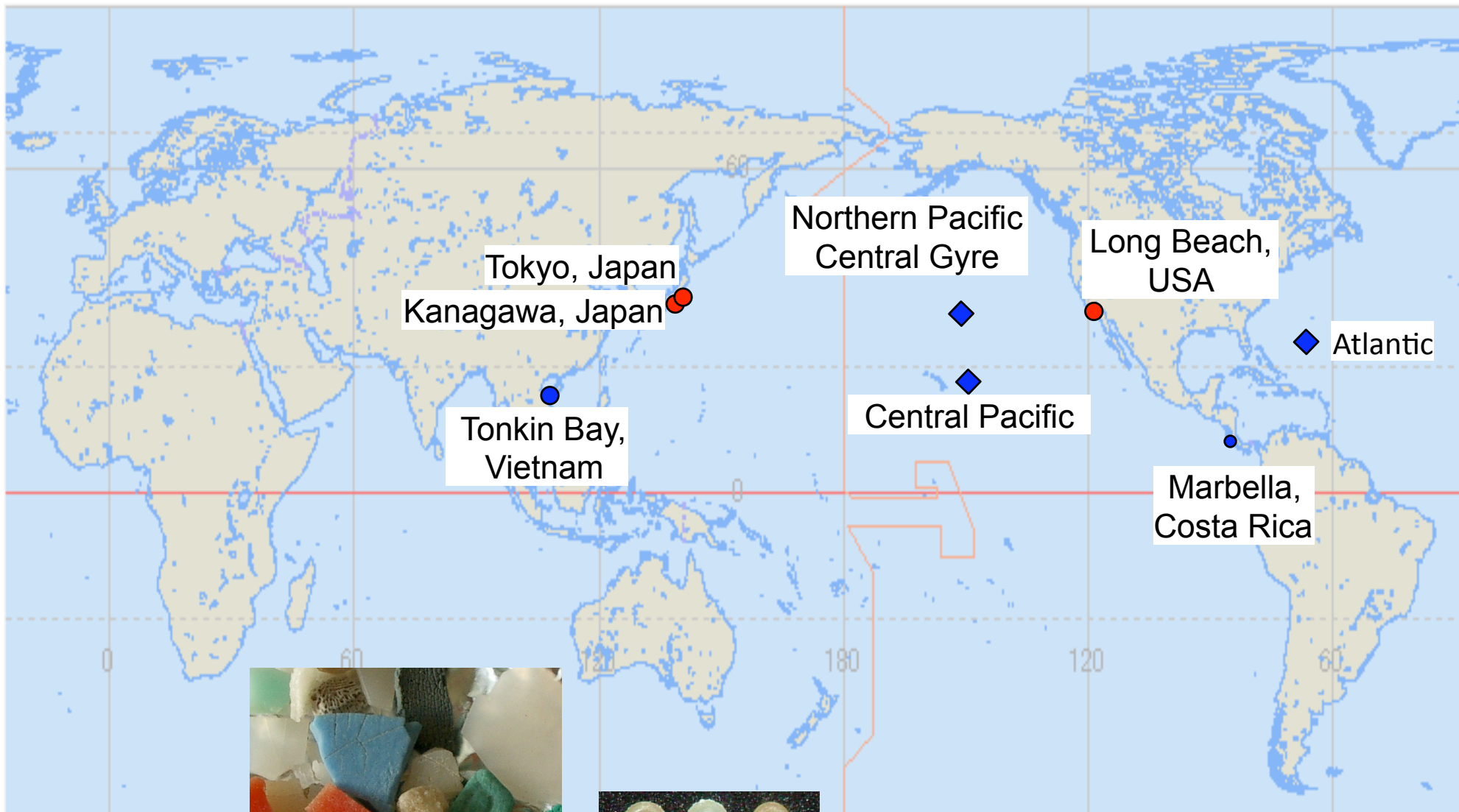
Sea Turtles Forever : Marc W Ward

Acknowledgement

Nico Zurcher, Ruchaya Booyatumanondo, Mohamad Pauzi Zakaria, Le Quang Dung, Milliam Gordon, Carlos Miguez, Satoru Suzuki , Charles Moore, Hrissi Karapanagioti, Steven Weerts, Tim McClurg, Erick Burren, Wally Smith, Mark Browne, Michael Van Velkenburg, Judith Selby Lang, Richard Lang, Duane Laursen, Brenda Danner, Nickol Stewardson, Richard Thompson, J.A. van Franeker, jorge mermoz, Luis Antonio Pinto Alvarez, Susan Freinkel, Barbara Beckingham, Martin Thiel, Taj Powell, Nagasawa Horyu, Hugh Patterson, Doug Young, Andrea Oliveira, John Ofosu-Anim,

Measurement of the concentrations of wide range of organic micropollutants in marine plastic fragments and their spatial pattern.

Sampling locations of user plastic fragments and pellets



- Urban beach
- Rural beach
- ◆ Open ocean

Analytical Procedure



Sorting by Nearinfrared spectrometer

Polyethylene (PE), polypropylene (PP)

Others



0.1 g – 1 g



Soxhlet Extraction

DCM; 24h

5% H₂O deactivated silica gel column chromatography

25% DCM/Hexane

60% DCM/Hexane

NP, OP

50% DCM/Acetone

BPA

Fully activated silica gel column chromatography

Acetylation

Acetylation

Hexane 3mL
Alkane

25% DCM/Hexane 30 mL
PAHs, PCBs, DDTs, PBDEs

GC-MS

GC-MS

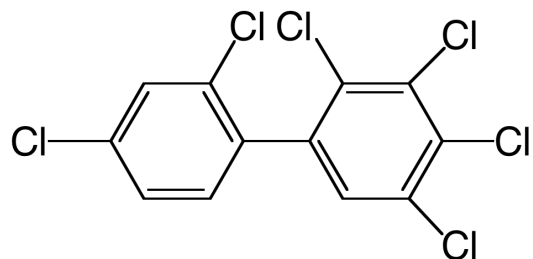
GC-MS : PAHs

GC-ITMS : PCBs, DDTs, PBDEs

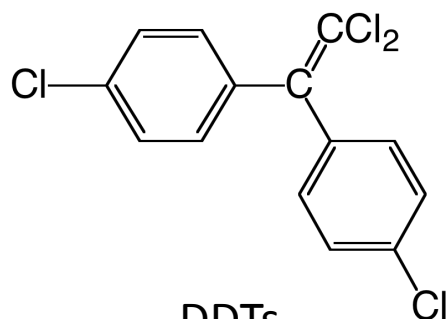
GC-ECD : BDE-209

Target compounds

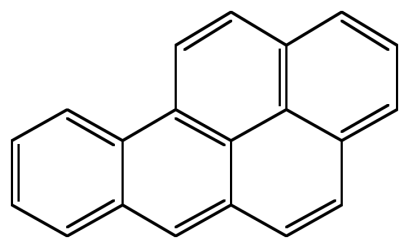
Sorption from ambient seawater



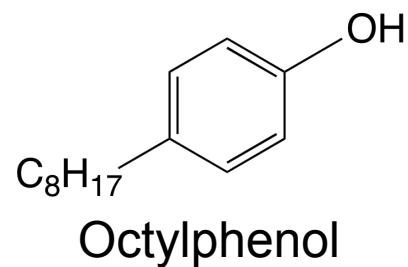
Polychlorinated biphenyl (PCBs)



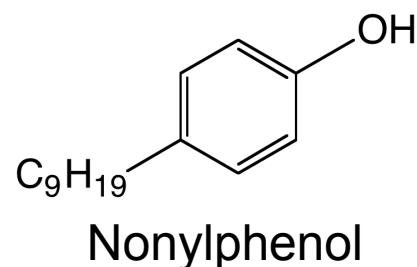
DDTs



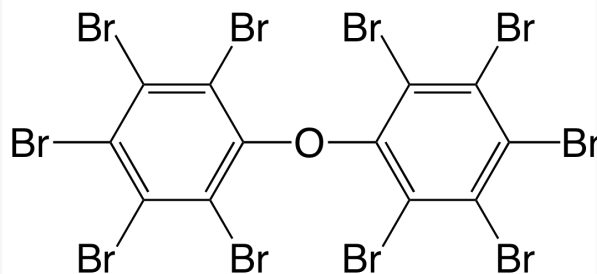
Polycyclic aromatic hydrocarbons (PAHs)



Octylphenol

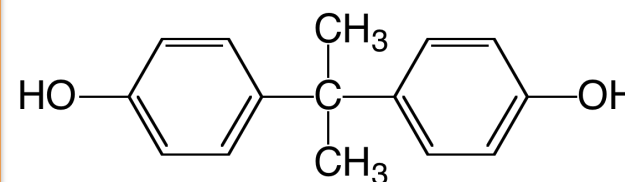


Nonylphenol



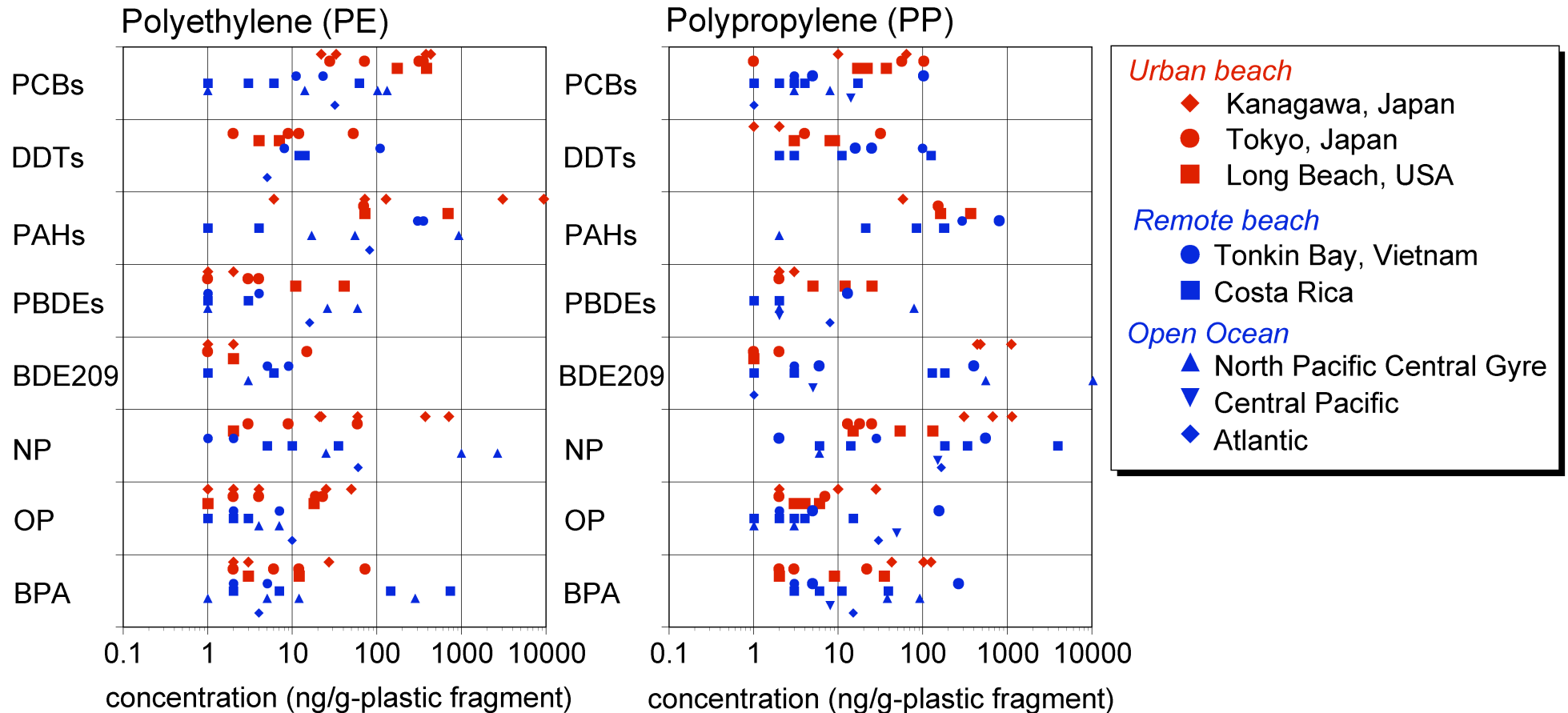
Polybrominated diphenyl ethers (PBDEs)

Additive-derived chemicals



Bisphenol A

Overview of the analytical results on the marine plastic fragments

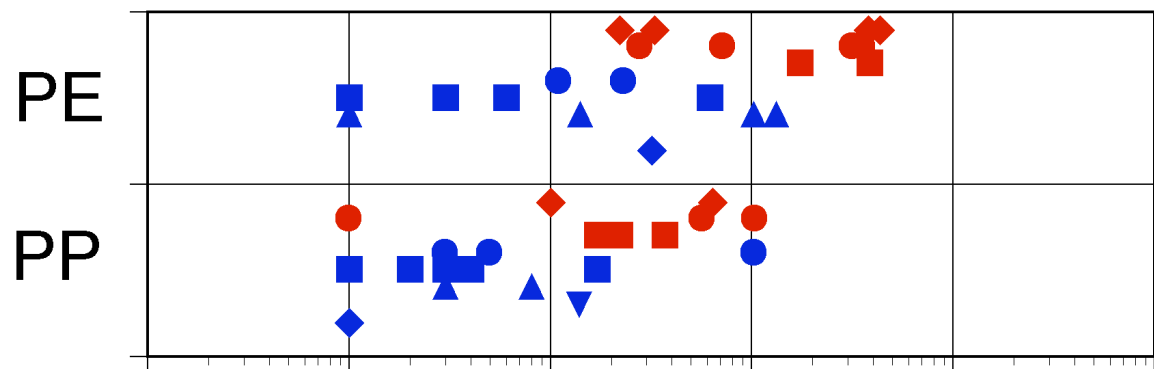


➡ Both sorption-derived and additive-derived chemicals ranging from 1 ng/g to 10 $\mu\text{g/g}$

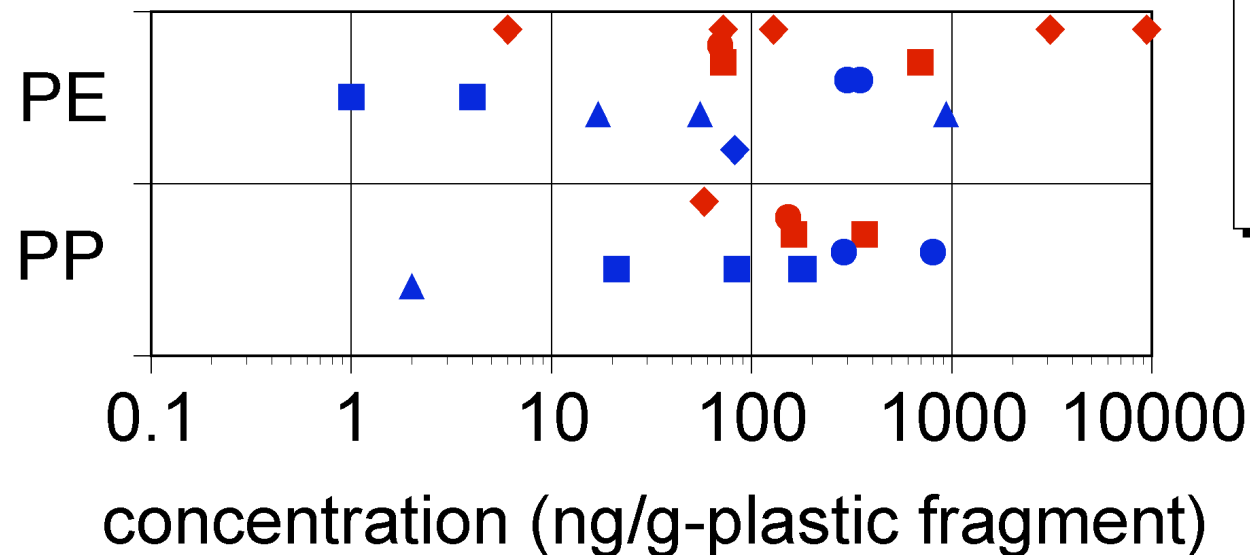
➡ Large variability among the fragments

Distribution of chemicals sorbed from seawater in plastic fragments

PCBs



PAHs



Urban beach

- ◆ Kanagawa, Japan
- Tokyo, Japan
- Long Beach, USA

Remote beach

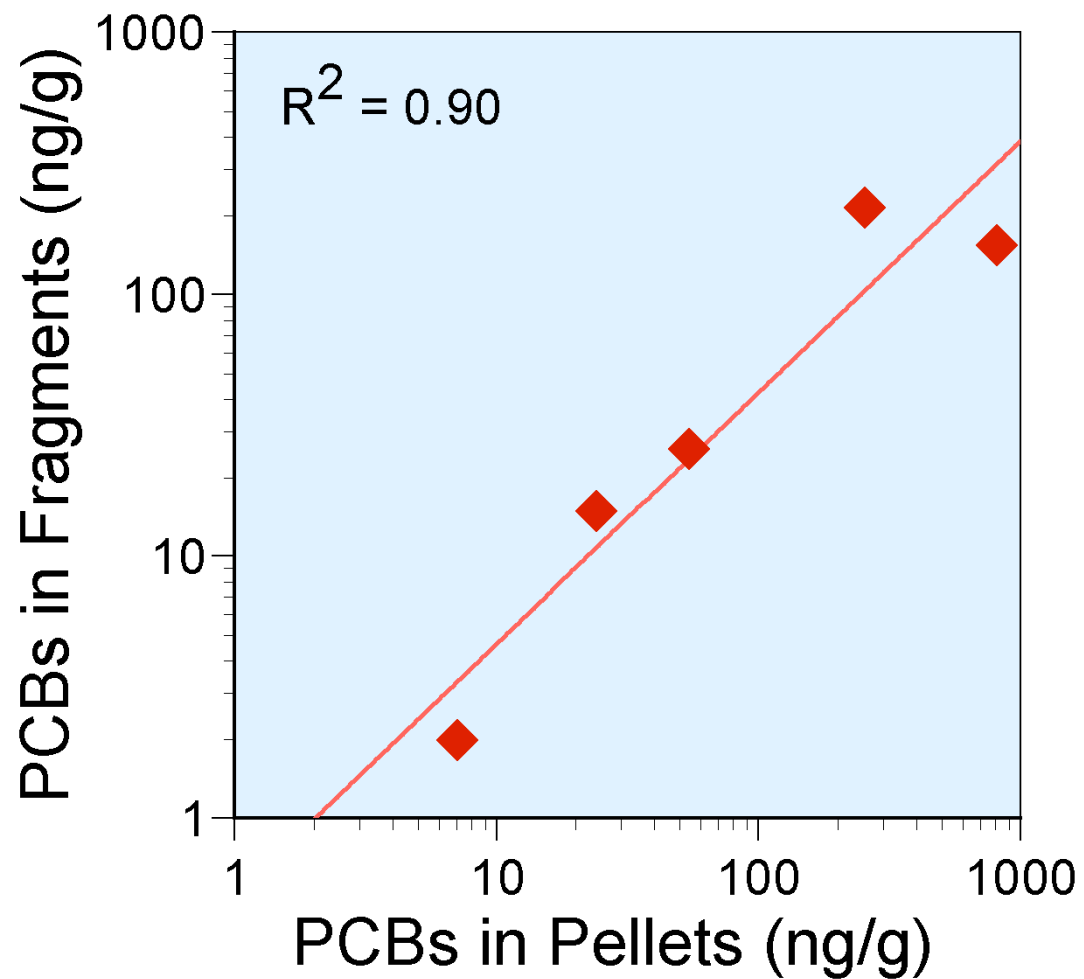
- Tonkin Bay, Vietnam
- Costa Rica

Open Ocean

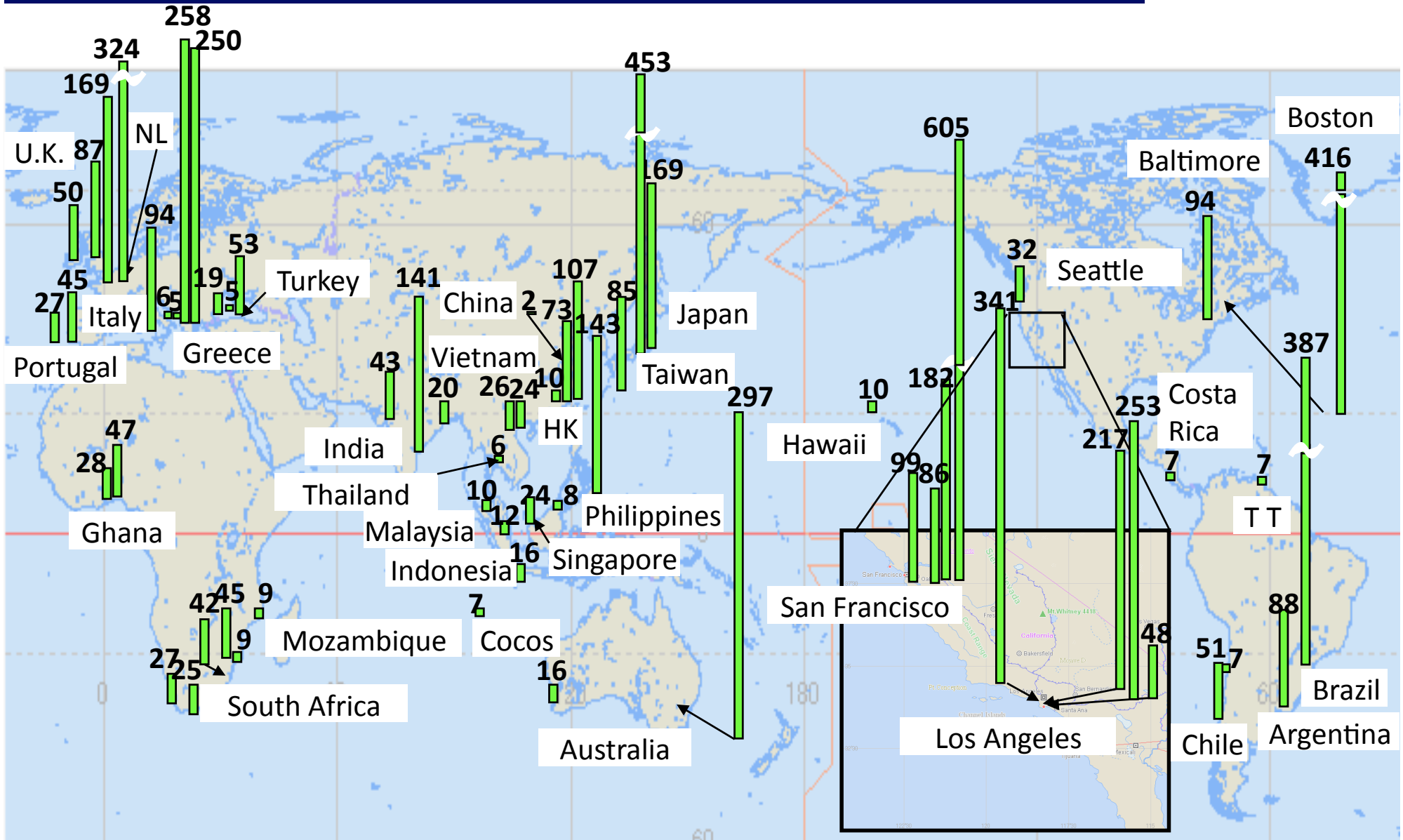
- ▲ North Pacific Central Gyre
- ▼ Central Pacific
- ◆ Atlantic

➔ Concentrations of hydrophobic pollutants were associated with anthropogenic activities.

Correlation of PCB concentrations between plastic fragments and plastic resin pellets



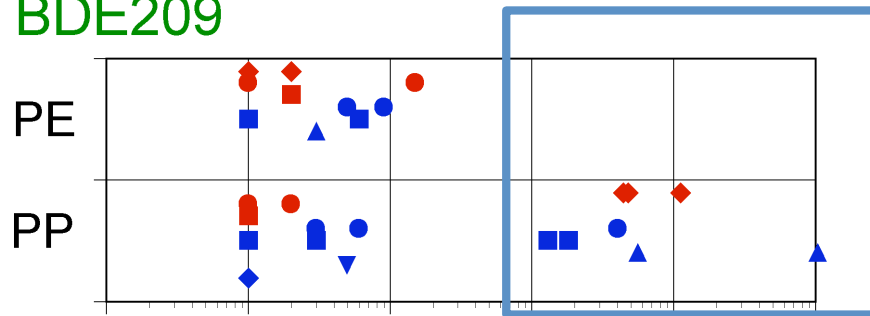
Analytical results of International Pellet Watch (IPW)



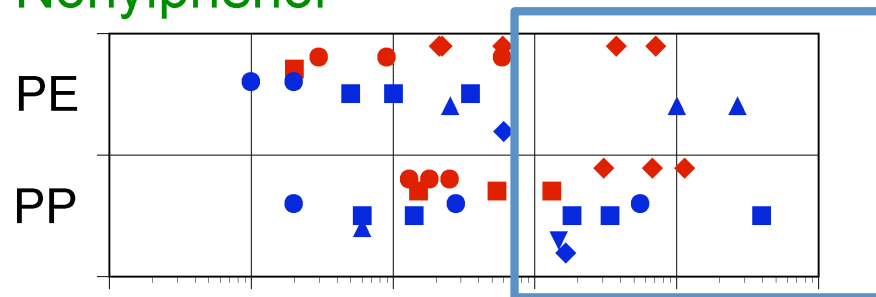
IPW tells us **spatial pattern of chemical risk** associated with marine plastics including **resin pellets** and **plastic fragments**.

Distributions of additive-derived chemicals in marine plastic fragments

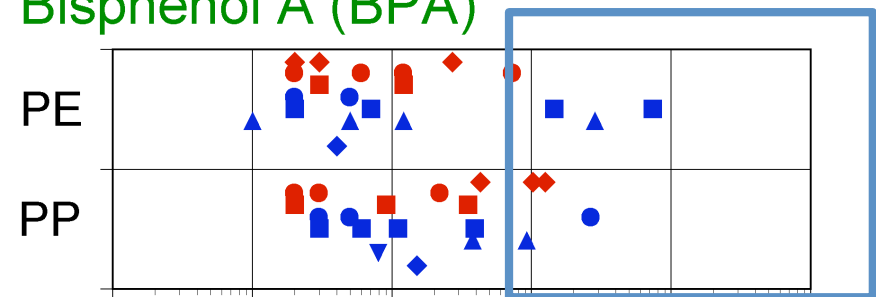
BDE209



Nonylphenol



Bisphenol A (BPA)



0.1 1 10 100 1000 10000

concentration (ng/g-plastic fragment)

Urban beach

- ◆ Kanagawa, Japan
- Tokyo, Japan
- Long Beach, USA

Remote beach

- Tonkin Bay, Vietnam
- Costa Rica

Open Ocean

- ▲ North Pacific Central Gyre
- ▼ Central Pacific
- ◆ Atlantic

➔ High concentrations of additive-derived chemicals were detected both in **remote** and **urban** areas