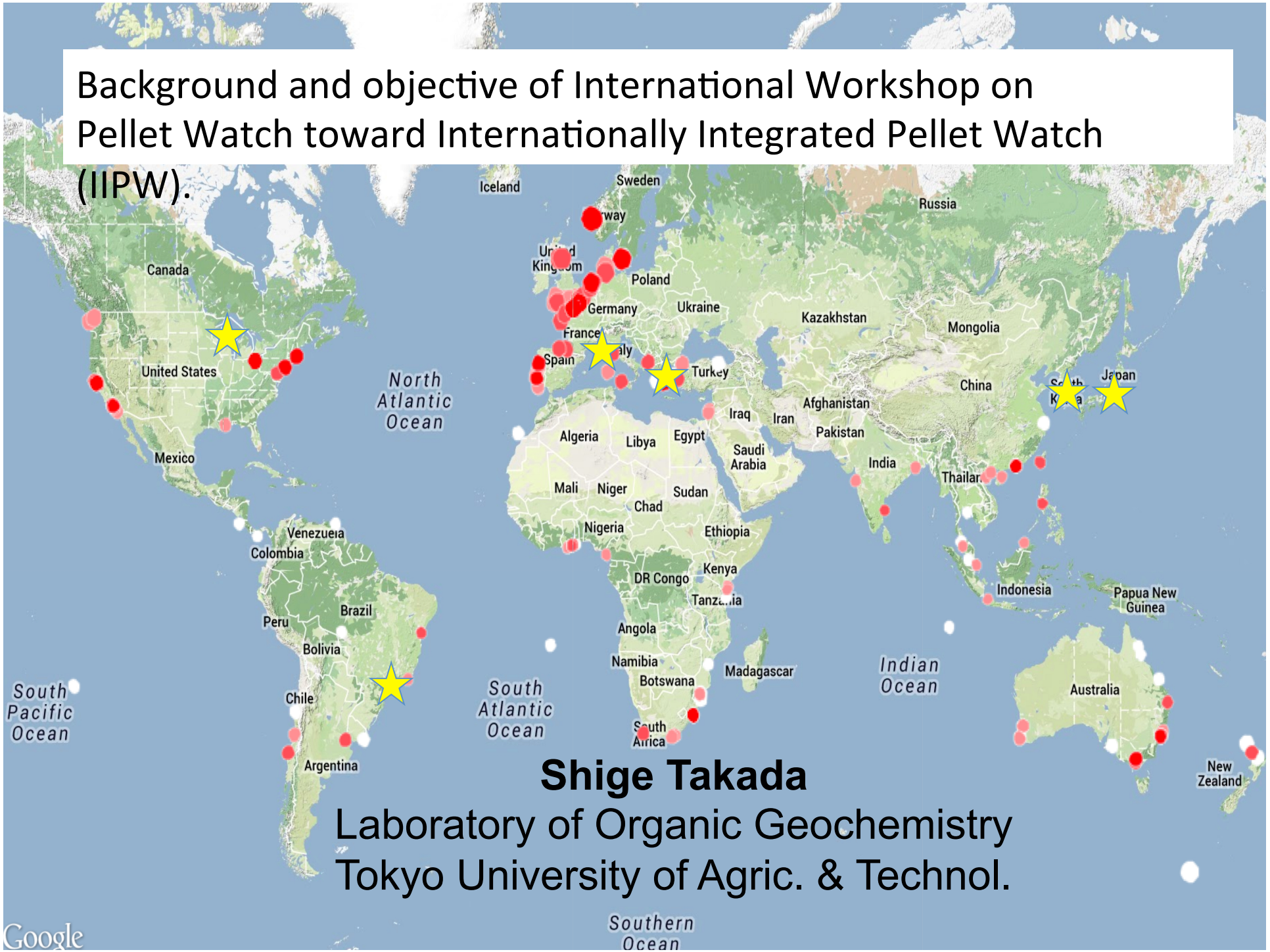
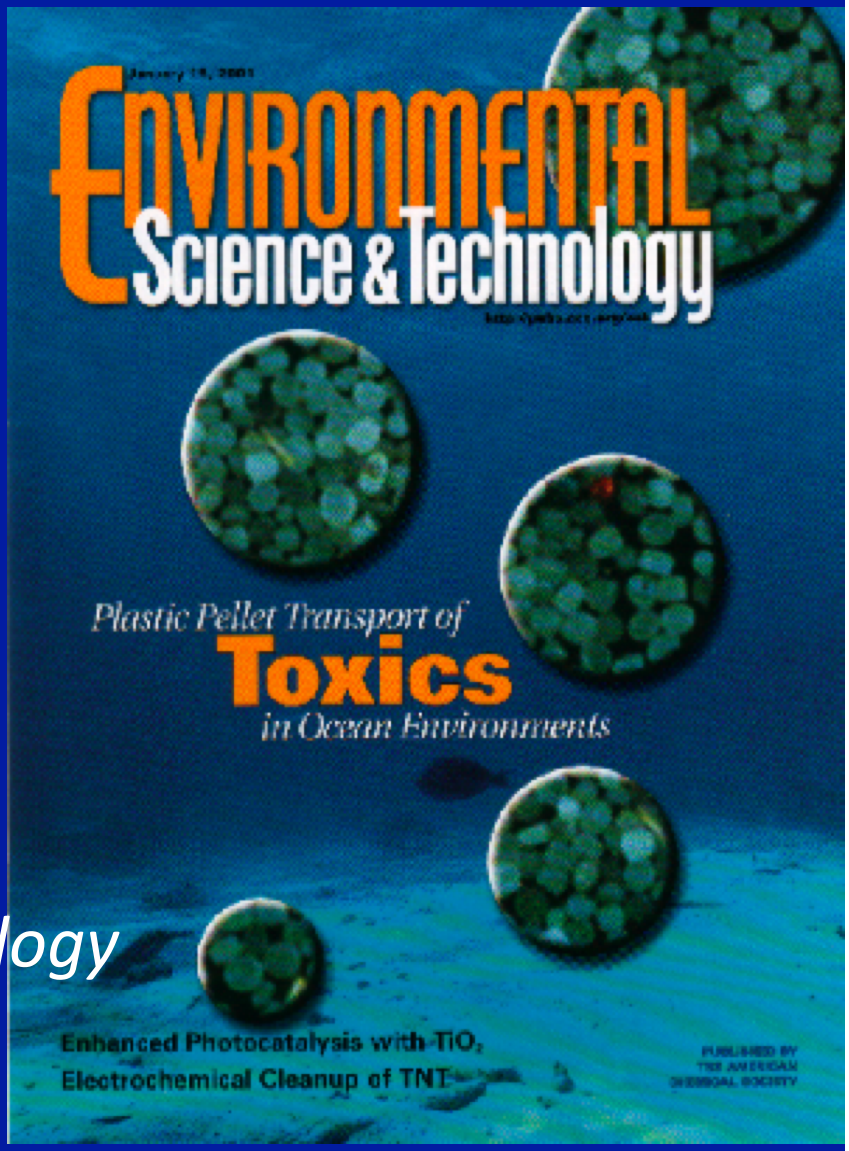
Background and objective of International Workshop on Pellet Watch toward Internationally Integrated Pellet Watch (IIPW).



Shige Takada
Laboratory of Organic Geochemistry
Tokyo University of Agric. & Technol.

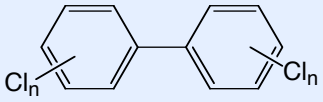
Plastic Resin Pellets as a Transport Medium for Toxic Chemicals in the Marine Environment



Environmental Science & Technology
2001, vol.35, 318-324

Pellets accumulate persistent organic pollutants (POPs) from seawater

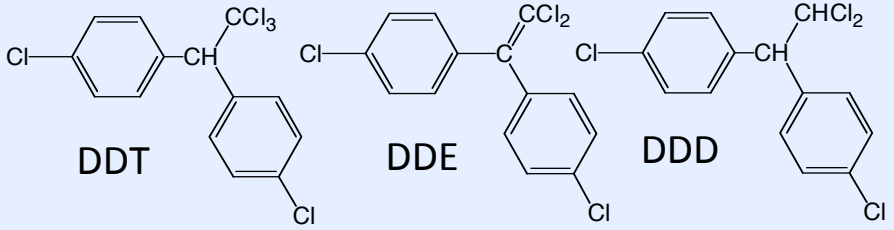
PCBs



- Industrial products for a variety of uses including dielectric fluid, heat medium, and lubricants.
- Endocrine disrupting chemicals

adsorption from ambient seawater

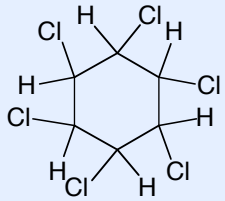
DDTs



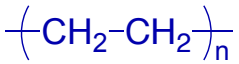
- DDT and its metabolites such as DDE and DDD.
- DDT was used as insecticides
- Endocrine disrupting chemicals

Pellet

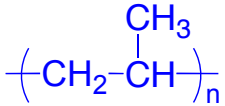
HCH



- Insecticide

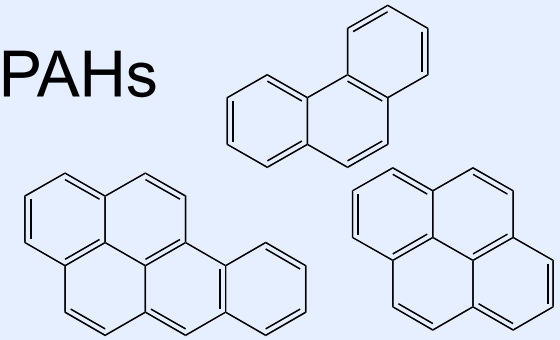


Polyethylene (PE)



Polyprorylene (PP)

PAHs



International Pellet Watch

Global Monitoring of Persistent Organic Pollutants (POPs) Using Beached Plastic Resin Pellets

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MARINE POLLUTION BULLETIN

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Since 2005

Editorial

Call for pellets! International Pellet Watch Global Monitoring of POPs using beached plastic resin pellets

On our beaches, we see various quantities of many materials (e.g., seaweed, driftwood, trash, plastic fragments, cigarette ends) along the high-tide line. Among them, we can commonly find plastic resin pellets. Recently we have started a global monitoring programme of persistent organic pollutants (POPs) using these stranded plastic resin pellets (International Pellet Watch: http://www.tuat.ac.jp/~gaia/ipw/index.html).

Plastic resin pellets are small granules, generally with shape of a cylinder or a disk with a diameter of a few mm (Fig. 1). These plastic particles are the industrial raw material of plastics which are transported to manufacturing sites where "user plastics" are made by re-melting the pellets and molding them into the final products. Resin pellets can be unintentionally released to the environment, both during manufacturing and transport. The released resin pellets are carried by surface run-off, streams and river waters, eventually leading to the ocean. Because of their environmental persistence, they are distributed widely in the ocean and are now found on beaches all over the world. In 2001, we revealed the existence of various organic micropollutants (i.e., polychlorinated biphenyls: PCBs, DDE, and nonylphenol) in these stranded plastic resin pellets collected on beaches (Mato et al., 2001).

Fig. 1. Plastic resin pellets.

Because of the hydrophobic nature of the plastic surfaces, hydrophobic pollutants such as PCBs and DDTs are adsorbed to the pellets from the surrounding seawater with concentration factors of up to 10^6. We observed a weak correlation between PCBs concentrations in plastic resin pellets collected on beaches with levels in traditional monitoring media (i.e., mussels), although large piece-to-piece variability of PCB concentrations was also observed (Endo et al., 2005). Because the resin pellets are distributed on beaches the world over, and because collection and shipping of the pellets are easy, we propose global monitoring of persistent organic pollutants (POPs) using these beached plastic resin pellets.

In the International Pellet Watch project, we ask people from all countries to collect plastic resin pellets on their nearby beaches and send them to our laboratory via airmail. No cooling nor freezing is necessary during shipment. People just need to put the pellets into a paper envelope and post it to us. To get representative data, we need 100–200 pieces of pellets (preferably yellowed pellets) from each location. Organic micro-pollutants in the pellets will be analyzed in our laboratory. Based on the analytical results, global distributions of these organic micro-pollutants will be mapped. Results will be sent to the participants through e-mail and will be released on the web as well.

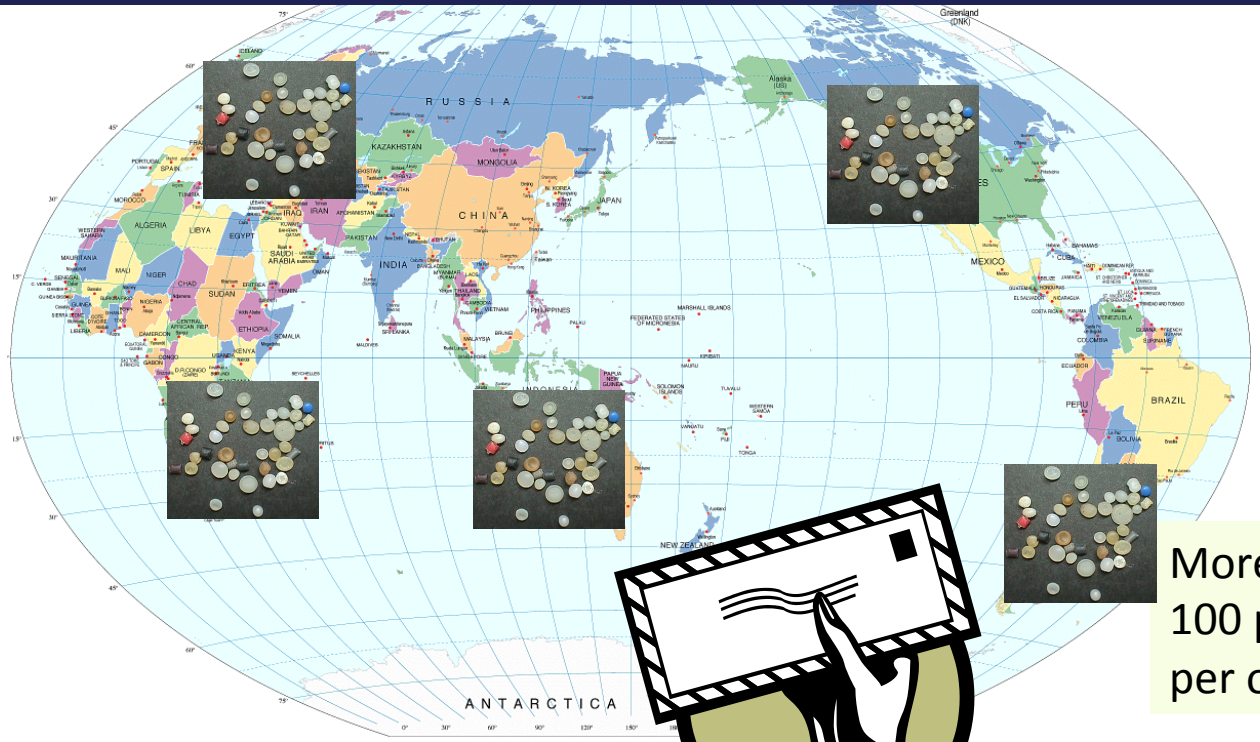
The purpose of International Pellet Watch is to understand the current status of global POPs pollution, and the advantage of Pellet Watch is its extremely low cost of sampling and shipping as compared with conventional monitoring using water, sediment and biological samples. Further, we can draw global POPs pollution maps for a very low cost. Already several NGOs who conduct beach clean-up projects are helping with sample collection.

So far, our spatial coverage is very limited and of course the strength of the programme will be related to the coverage

0025-326X/$ - see front matter
doi:10.1016/j.marpolbul.2006.10.010

International Pellet Watch

Global Monitoring of Persistent Organic Pollutants (POPs) Using Beached Plastic Resin Pellets



More than 50 pieces (~ 100 pieces)
per one location

Laboratory of Organic Geochemistry, Dr. Hideshige Takada,
Tokyo University of Agriculture and Technology,
Fuchu, Tokyo 183-8509, Japan

Laboratory of Organic Geochemistry
Dr. Hideshige Takada,
Tokyo University of Agriculture and Technology,
Fuchu, Tokyo 183-8509, Japan

More than 50 pieces (~100 pieces) per one location

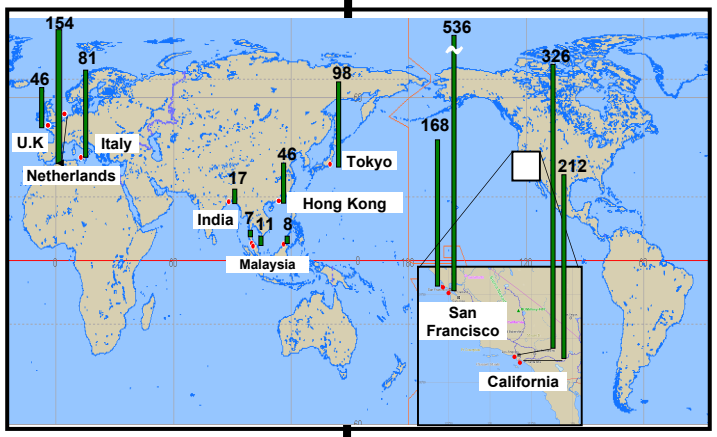
Sorting

PE, yellowing pellets

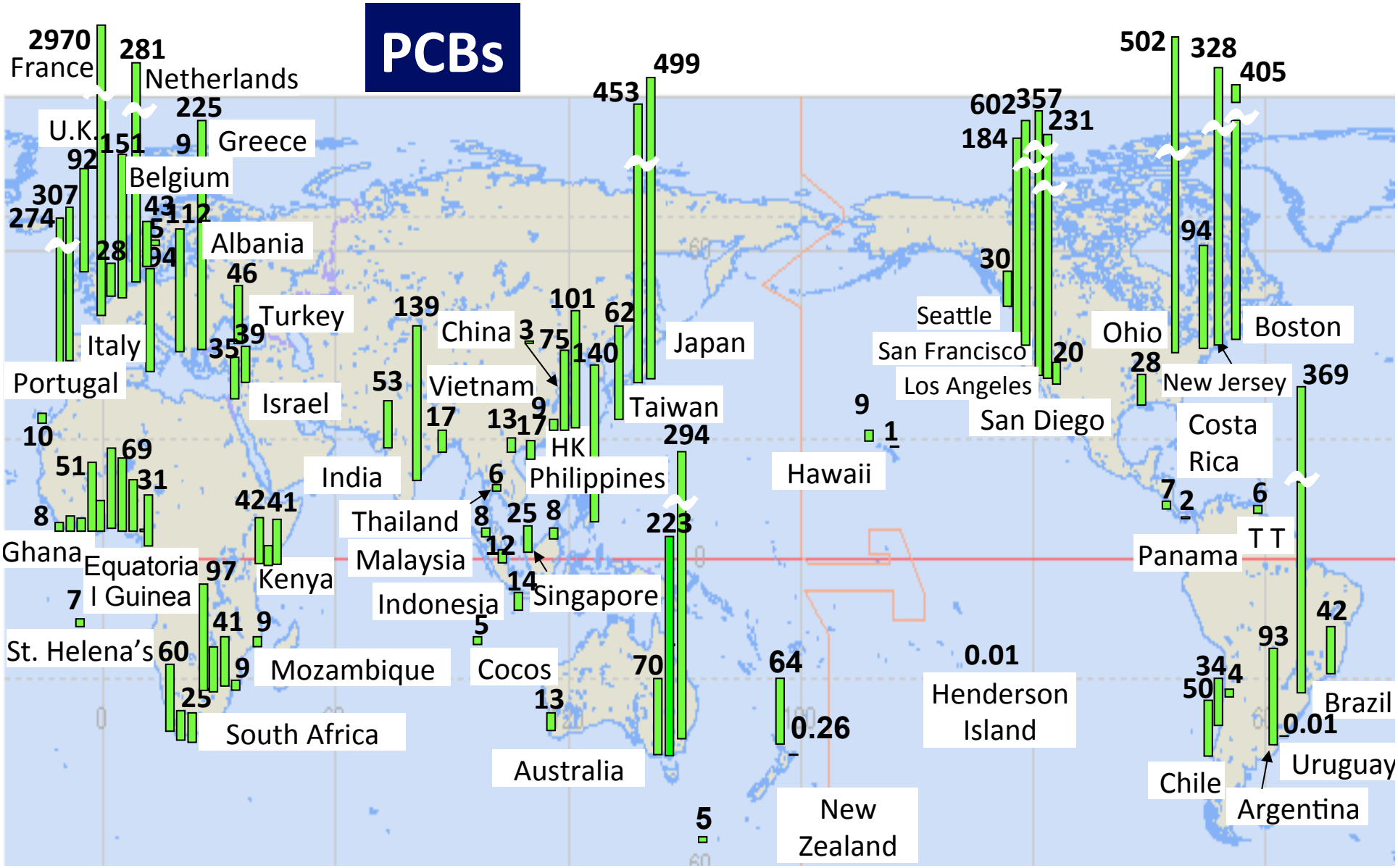
Analysis for POPs (PCBs, organochlorines, PAHs)

By GC-MS/MS, GC-MS, GC-ECD
more than 5 pools of 5 pellets
to exclude sporadic high concentration

Mapping POPs pollution



- **Sending the data** via Internet to the collaborators
- **Releasing** the results on **web**



Concentration of PCBs* in beached plastic resin pellet (ng/g-pellet)

*sum of concentrations of CB#66, 101, 110, 149, 118, 105, 153, 138, 128, 187, 180, 170, 206

Measured by Polaris Q (Thermo Fisher Scientific)

International Pellet Watch has 2 aspects

To provide basis information to assess the risk of toxic chemicals in microplastics

To scientists, policy-makers

Tool to increase public awareness of plastic pollution

Global Monitoring of POPs in marine and lake environments

Importance of sustainable Global monitoring of POPs

Stockholm convention

Media for Global Monitoring

- Water
- Sediment
- Biological samples (e.g., mussel)

Monitoring with low cost

Advantage of International Pellet Watch

Extremely low cost for sampling and shipping

No special training is necessary for sampling

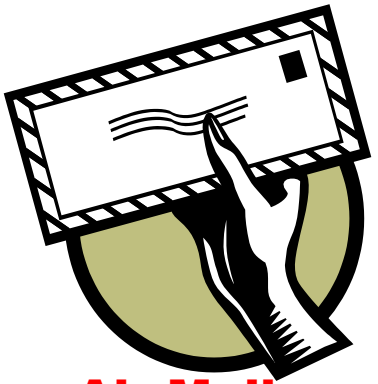
↓

World citizens can join

↓

Wide area (globe) can be covered using minimal cost

4,000 USD

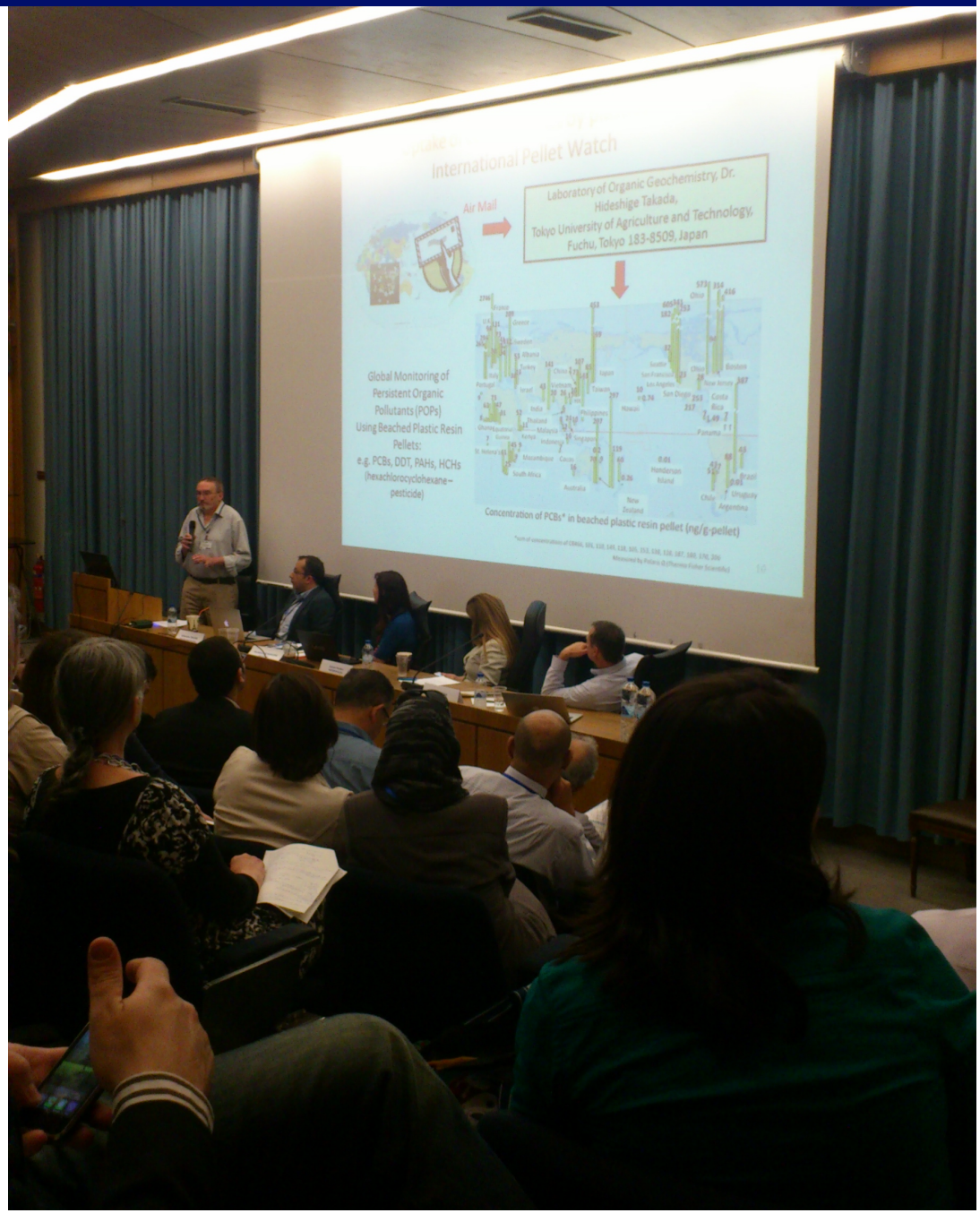


Air Mail

~1 USD

International Agency recognize utility of IPW

Dr. Peter Kershaw (GESAMP) initiated the activity of international integration of pellet watch.



Transboundary Waters Assessment Programme (TWAP) supported by Global Environment Facility

TWAP

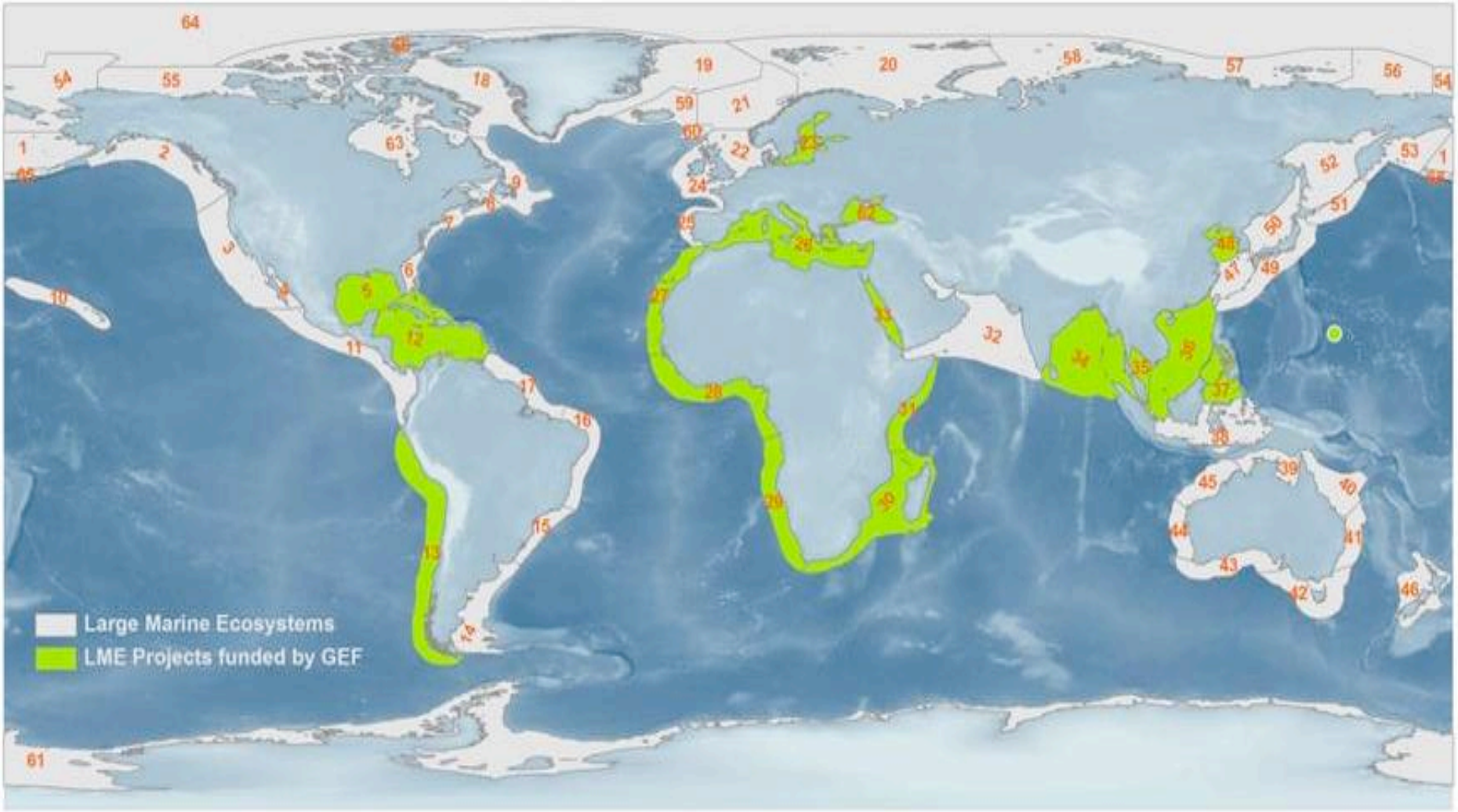
Transboundary Waters Assessment Programme (GEF TWAP) to provide the first global-scale assessment and improve knowledge for informed decision-making, raise awareness and foster cooperation among all stakeholders.

http://www.geftwap.org/

LMEs

The Intergovernmental Oceanographic Commission (IOC) of UNESCO is leading the assessment of Large Marine Ecosystems (LMEs).

The LMEs assessment is based on six themes: productivity, fisheries, habitats, pollution, socio-economics and governance. For each theme, a number of indicators of current status (and future projections for a limited number of indicators) will be used in a global comparative baseline assessment of all 66 LMEs and the Pacific Warm Pool. Results of the assessment will assist in identifying LMEs that are at most risk and where human dependency is greatest. The assessment will also provide an important baseline for future assessments to help GEF and others track changes in LME state.


Large Marine Ecosystems
LME Projects funded by GEF


Greenland
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Sweden
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Poland
Germany
Ukraine
Kazakhstan
Mongolia
France
United States
North Atlantic Ocean
Spain
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China
South Korea
Japan
Afghanistan
Iraq
Iran
Pakistan
Algeria
Libya
Egypt
Saudi Arabia
India
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Marine Pollution Bulletin 54 (2007) 1230–1237
MARINE POLLUTION BULLETIN
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Persistent organic pollutants carried by synthetic polymers in the ocean environment

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Abstract

Thermoplastic resin pellets are melted and formed into an enormous number of inexpensive consumer goods, many of which are discarded after a relatively short period of use, dropped haphazardly onto watersheds and then make their way to the ocean where some get ingested by marine life. In 2003 and 2004 pre-production thermoplastic resin pellets and post-consumer plastic fragments were collected and analyzed for contamination for persistent organic pollutants (POPs). Samples were taken from the North Pacific Gyre, and selected sites in California, Hawaii, and from Guadalupe Island, Mexico. The total concentration of PCBs ranged from 27 to 980 ng/g; DDTs from 22 to 7100 ng/g and PAHs from 39 to 1200 ng/g, and aliphatic hydrocarbons from 1.1 to 8600 μg/g. Analytical methods were developed to extract, concentrate and identify POPs that may have accumulated on plastic fragments and plastic pellets. The results of this study confirm that plastic debris is a trap for POPs.

Keywords: Persistent organic pollutants; Plastic contaminants; PCBs in plastics; DDTs in plastics; PAHs in plastics; Plastic debris; Plastic pellets

ORGANOCHLORINE PESTICIDES IN PLASTIC PELLETS FROM SANTOS, SOUTHEASTERN COAST OF BRAZIL

Satie Taniguchi[1], Fernanda Imperatrice Colabuono[1], Patrick S. Dias[1], Martlia G. M. Batista[1], Renato Oliveira[1], Mara Fisner[2], Alexander Turra[2], Marcia C. Bicego[1] & Rosalinda C. Montone[1]*

1- Laboratório de Química Orgânica Marinha –

2 - Laboratório de Manejo, Ecologia e Conservação Marinha

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INTRODUCTION

Small plastic granules are industrial raw material and can be unintentionally released to the environment (Mato et al., 2001) and consequently they are present in worlwide oceans and beaches representing an important constituent of marine pollution has been reported since 70's (Turra, 2008). Persistent organic pollutants (POPs) are sorbed to plastic resin pellets in the water (Endo et al, 2005) and can be a significant pathway for chemicals to enter marine organisms through the food web (Ryan, 1988).

The objetive of this study was the assessment of POPs in plastic pellets found in the Embaré beach, Southeastern Coast of Brazil

MATERIALS & METHODS

Embaré beach is located in Baixada Santista, São Paulo State, Brazil, where the most important industrial complex of the country is located. The biggest port of Latin America, Porto de Santos, and an important contribution of waste disposal can also be found in that region.

RESULTS & DISCUSSIONS

The virgin pellets did not present concentrations above the method detection limit (MDL) in any group of compounds analyzed. PBDE amount was below MDL. The PCBs (sum of 51 congeners) concentrations ranged from 531 to 1021 ng g^{-1}. The sum of 13 congeners described in Ogata et al. (2009) presented concentration from <0.51 to 666 ng $g^{-1}$and are similar to sites of USA, Japan and Western Europe related by these authors. The PCB concentration increased with the weathering condition of pellet as showed in Fig. 4.

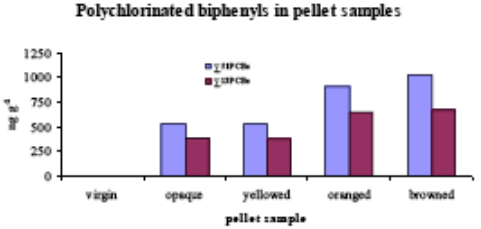

Figure 4: PCBs in pellet samples from Embaré beach, São Paulo, Brazil

The distribution of PCB homologs (Fig. 5) was similar in all classes of pellets and hexachlorobiphenyls (PCB138>149>153) were predominant followed by heptachlorobiphenyls (PCB180>170>187). This pattern is a little different from that found by Bicego et al. (2006) in sediment samples of the same area in Southern Brazil where pentachlorbiphenyls were predominant.

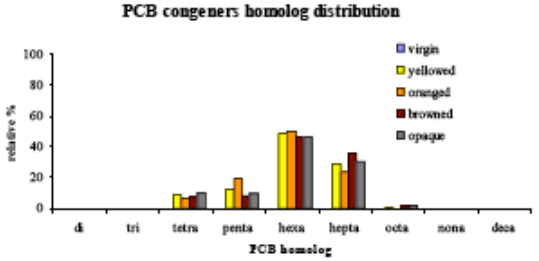

Figure 5: PCBs homologs distribuition in pellet samples from Embaré beach, São Paulo, Brazil

The range of concentrations for several OCPs found were: 10.5 to 23.3 ng g^{-1} for HCB, 79.5 to 336 ng g^{-1} for HCHs, 77.6 to 2569 ng g^{-1} for DDTs and 4.88 to 440 ng g^{-1} for chlordanes.

Marine Pollution Bulletin 70 (2013) 219–226

Contents lists available at SciVerse ScienceDirect

Marine Pollution Bulletin

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Polycyclic aromatic hydrocarbons (PAHs) in plastic pellets: Variability in the concentration and composition at different sediment depths in a sandy beach

Mara Fisner [a,b,*], Satie Taniguchi [c], Fabiana Moreira [a,b], Márcia C. Bícego [c], Alexander Turra [a]

[a] Laboratório de Manejo, Ecologia e Conservação Marinha, Instituto Oceanográfico, USP, São Paulo, SP, Brazil
[b] Programa de Pós-Graduação em Oceanografia, Instituto Oceanográfico, USP, São Paulo, SP, Brazil
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ARTICLE INFO

Keywords:
Nibs
Plastic pellets
Plastic pollution
Polycyclic aromatic hydrocarbons (PAHs)
Beach sediment

ABSTRACT

Plastic pellets have the ability to adsorb organic pollutants such as PAHs. This study analyzed the variability in the concentration and composition of PAHs on plastic pellets sampled up to 1 m deep in the sediment of a sandy beach. The toxic potential of PAHs was analyzed, and the possible sources of contamination are discussed. The total PAHs varied, with the highest concentrations in the surface layer; the priority PAHs showed a different pattern. PAHs at greater depths did not reach toxicity levels above the PEL. The composition of PAHs differed between pellets from the shallower and from deeper sediment layers, and was suggested a mixture of sources. These results provided the first information on the depth distribution of PAHs in sandy beaches, associated with plastic pellets; and evidenced the potential environmental risk. Similarly to the abundance of pellets, the toxic potential is underestimated in surface samples.

Organic micropollutants in plastic resin pellets from sand beaches of South Korea

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Oil and POPs Research Group, Korea Institute of Ocean Science and Technology, 391 Jangmok-ri, Jangmok-myon, Geoje-shi 656-834, Korea
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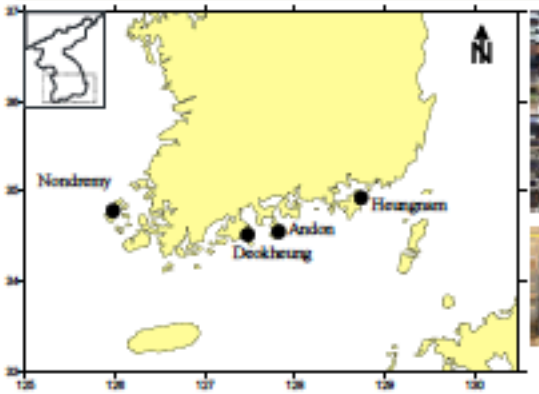
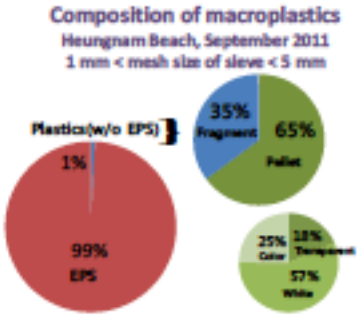
INTRODUCTION

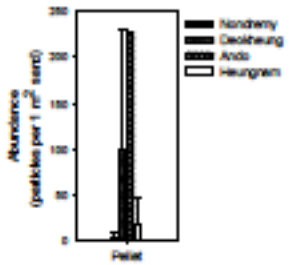
Plastic products are massively produced since 1950s, and an estimated 250 million ton/yr is produced with a 10% increase in production each year (Plastic Europe, 2008). Currently, marine debris is of global environmental concern. About 50-80% of the wastes stranded on beach are plastics. Due to their buoyant and persistent properties, plastics have the potential to become widely dispersed in the marine environment by hydrodynamic process and ocean current. Plastic resin pellets, small granules with shape of a cylinder or a disk with a diameter of a few mm, are one of the major components of plastic debris in the marine environment. They are the industrial raw material for the production of plastic products, and can be unintentionally released to the environment during manufacturing and transportation. The released pellets are carried by surface runoff, stream, and river waters to the ocean. Plastic debris may act as a transfer medium for toxic substances such as persistent organic pollutants (POPs) by adsorption from the surrounding waters. Mato et al. (2001) proposed the potential use of beached plastic pellet as a passive sampling tool for monitoring the pollution of persistent organic pollutants in the marine environment. Based on that concept, the global monitoring of POPs using stranded resin pellet was attempted (Ogata et al., 2009). Ingestion of the plastics could be an exposure route of the toxic chemicals to marine organisms, and leads to adverse effects on the organisms. In order to assess the status of plastic pollution and its associated toxic chemicals in the Korean coastal environment, beach monitoring studies were conducted for four Korean beaches.

MATERIALS & METHOD

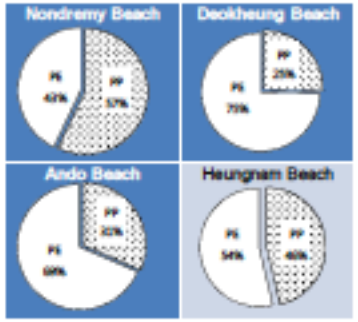


Study area and Sampling strategy Beach survey was conducted at four sand beaches (Nondremy, Deokheung, Ando and Heungnam) in the southern coast of Korea between September and October 2011. To understand the pollution status of microplastic debris and its spatial distribution pattern on the beaches, sampling was conducted at low tide. Ten sampling points were randomly selected at the high stranded lines of each beach. About top 5cm of surface sand in a quadrat (50cm x 50cm) was sieved using 1mm and 5mm mesh size of sieves and plastics



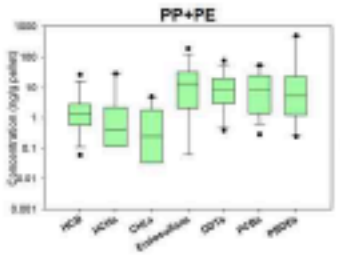


Identification of polymer types using a FT-IR

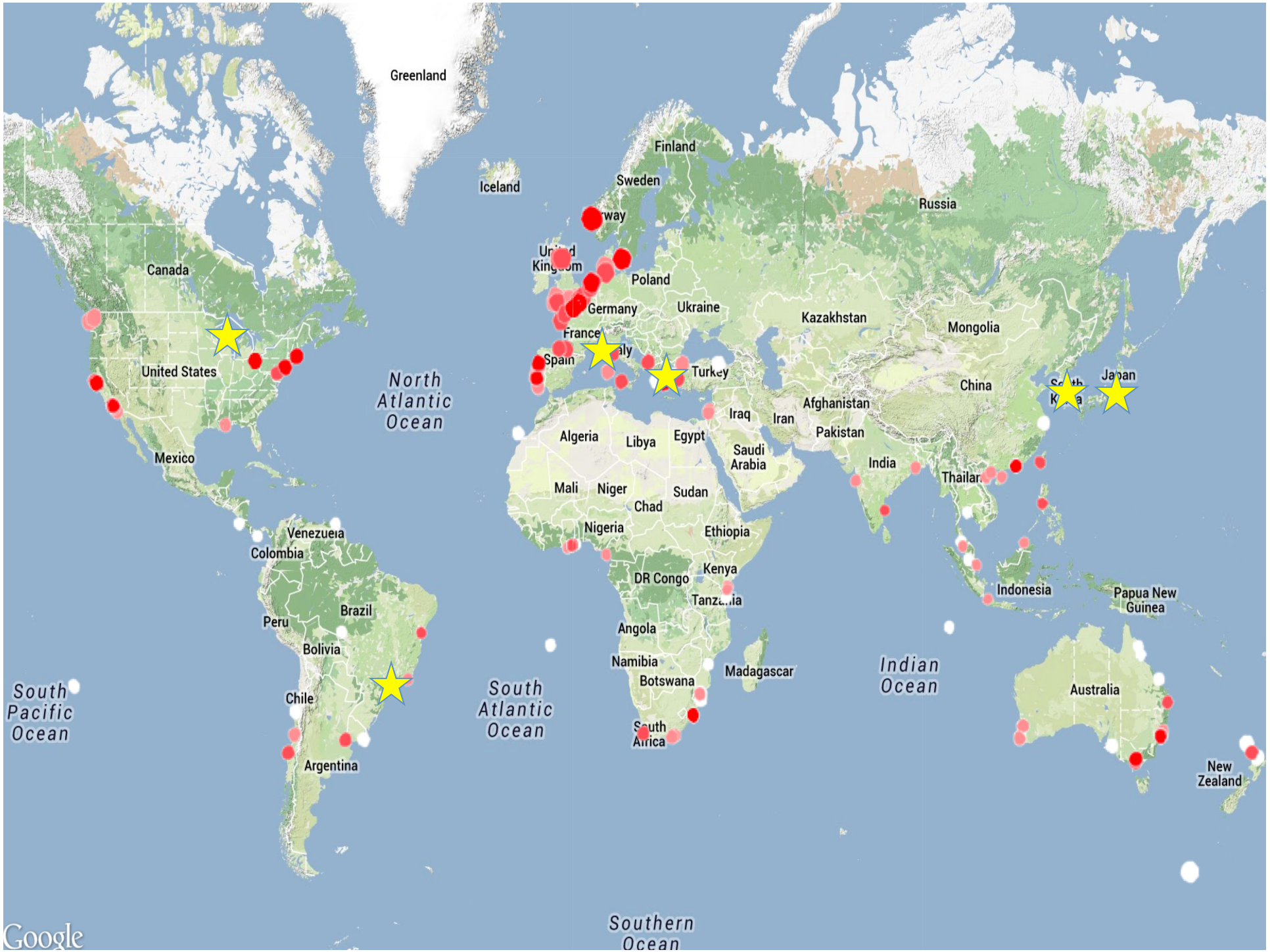


POPs in beached plastic resin pellet

Persistent organic pollutants such as organochlorine pesticides, PCBs, and PBDEs were detectable in the resin pellets from the Korean beaches. The overall concentration (ng/g pellet) of POPs in pellet samples were in the range of 0.06-18.6 (median value: 1.75) for HCB, nd-29.4 (0.62) for HCHs, nd-4.9 (0.13) for CHLs, nd-193 (14) for endosulfans, 0.39-77.6 (8.06) for DDTs, 0.3-55.3 (8.37) for PCBs, and 0.25-510 (5.38) for PBDEs. Among the target compounds, DDTs, PCBs, PBDEs and endosulfans showed higher concentration than the other chemicals. The profile of POPs detected in the pellet is relatively similar to those in marine sediment from the Korean coastal environment. In general, PE accumulated larger amounts of POPs than PP. And aged pellet accumulated more contaminants than the fresh.



International Pellet watch
(http://www.pelletwatch.org)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North Atlantic Ocean
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Mali
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Sudan
Chad
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Ethiopia
Venezuela
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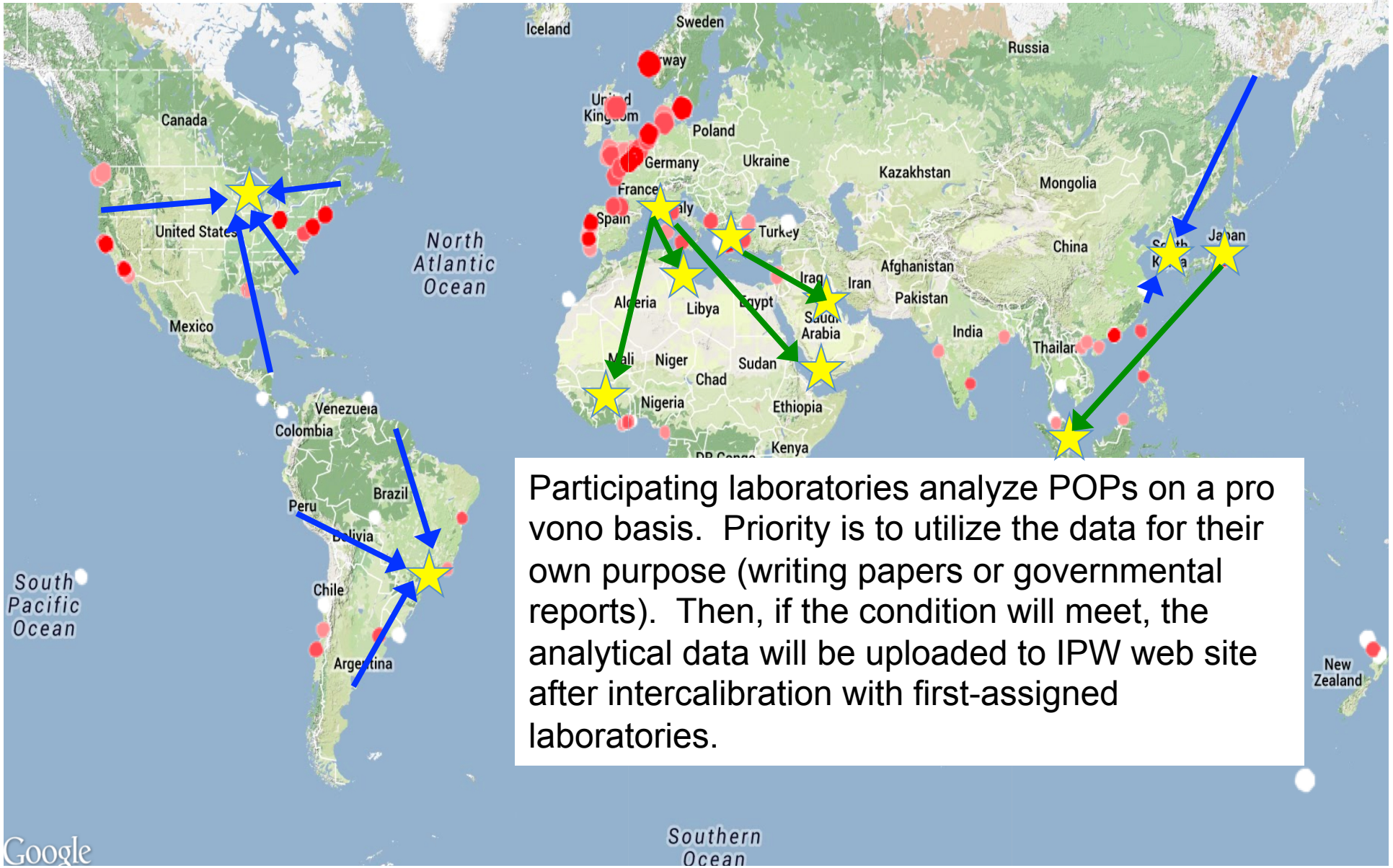
To plots data from regional pellet watch, understanding the difference in analytical values among the laboratories is necessary.

To utilize our existing data on global scale, we need to make intercalibration.

Dream :
International network of Analysis of POPs in Pellet (INAPOP)



Participating laboratories analyze POPs on a pro vono basis. Priority is to utilize the data for their own purpose (writing papers or governmental reports). Then, if the condition will meet, the analytical data will be uploaded to IPW web site after intercalibration with first-assigned laboratories.

Objectives of the workshop

To utilize our existing data

Mutual understanding of researches on POPs in pellets.

Understanding the similarity and differences in POPs analysis among the laboratory.

To determine the practical procedure of intercalibration.

For future

To discuss feasibility of international network of analysis of POPs in pellets.