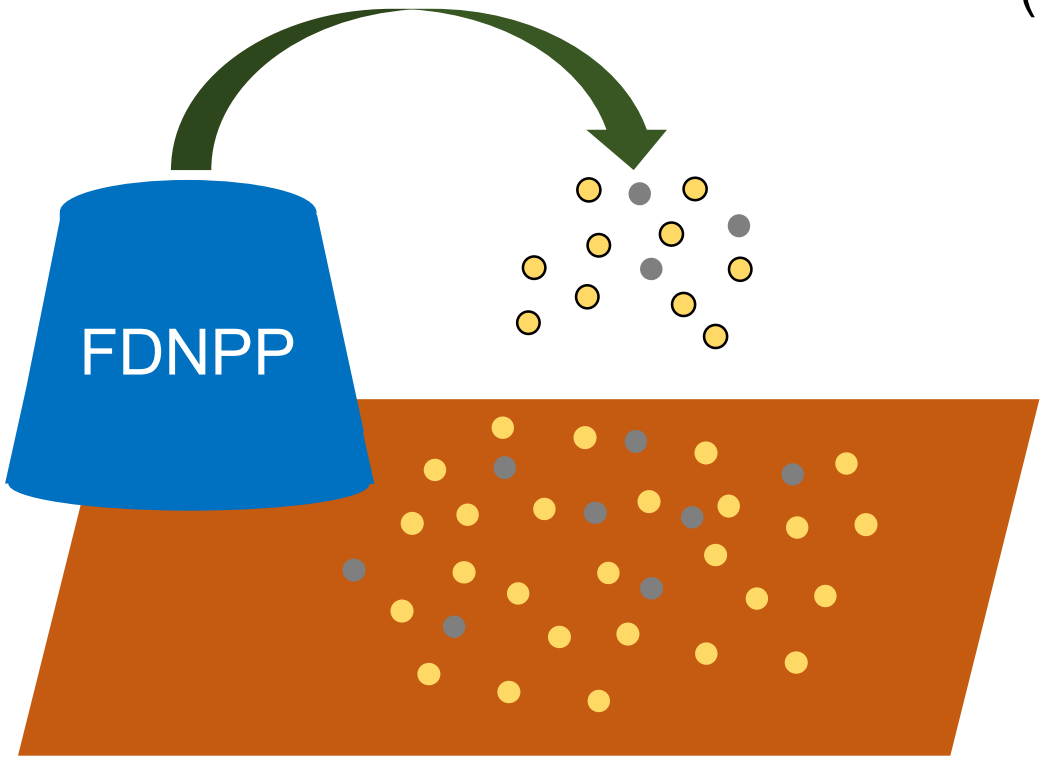
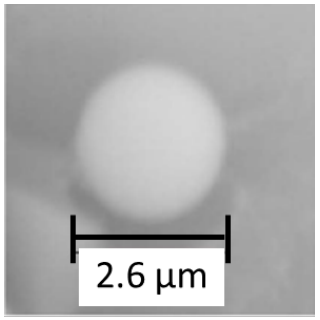
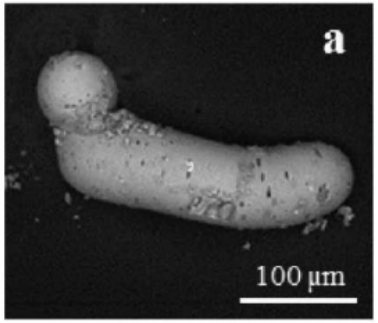
Introduction

- Soluble Cs → Sulfate aerosol
  Kaneyasu et al. (2012), Tanaka et al. (2013)
- Insoluble Cs → Cs-bearing radioactive microparticle (CsMP)





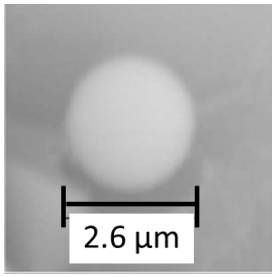
Adachi et al. (2013)



Ono et al. (2017)

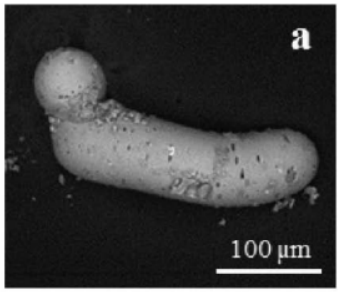
Introduction

Type A



(Adachi et al., 2013)

Type B



(Ono et al., 2017)

Similarities

- main component is SiO_2 → water-insoluble property
- Cs, Fe, Zn and …
- U and fission products → from FDNPP

Differences

	Type A	Type B
Source	Unit 2 or 3	Unit 1
Size	~1-3 µm	~50-300 µm
Shape	Spherical	Various
^{137}Cs activity	~0.5-4 Bq/particle	~30-100 Bq/particle

Purpose of this study

Separating CsMPs from ocean samples

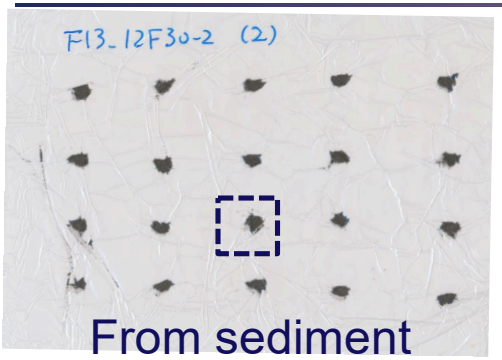
Analyzing CsMPs by HPGe and SEM-EDS

★Comparing CsMPs from ocean with CsMPs from land (Type-A or Type-B ?)

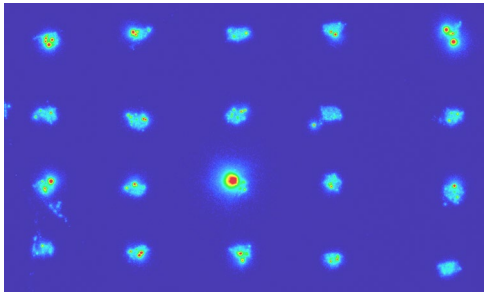
★How CsMPs behave in the ocean?

★what is the source of CsMPs?

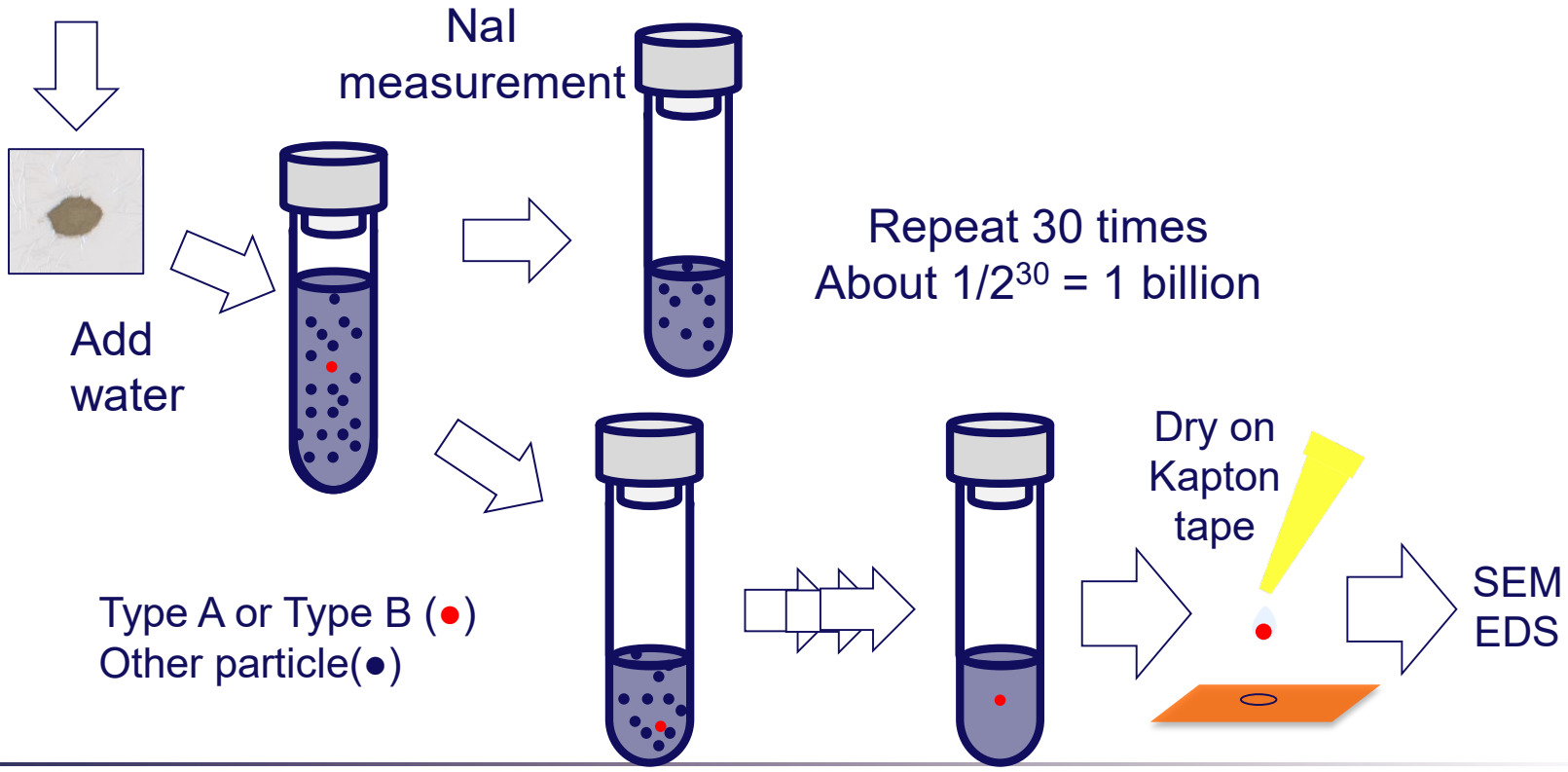
Wet separation by autoradiography



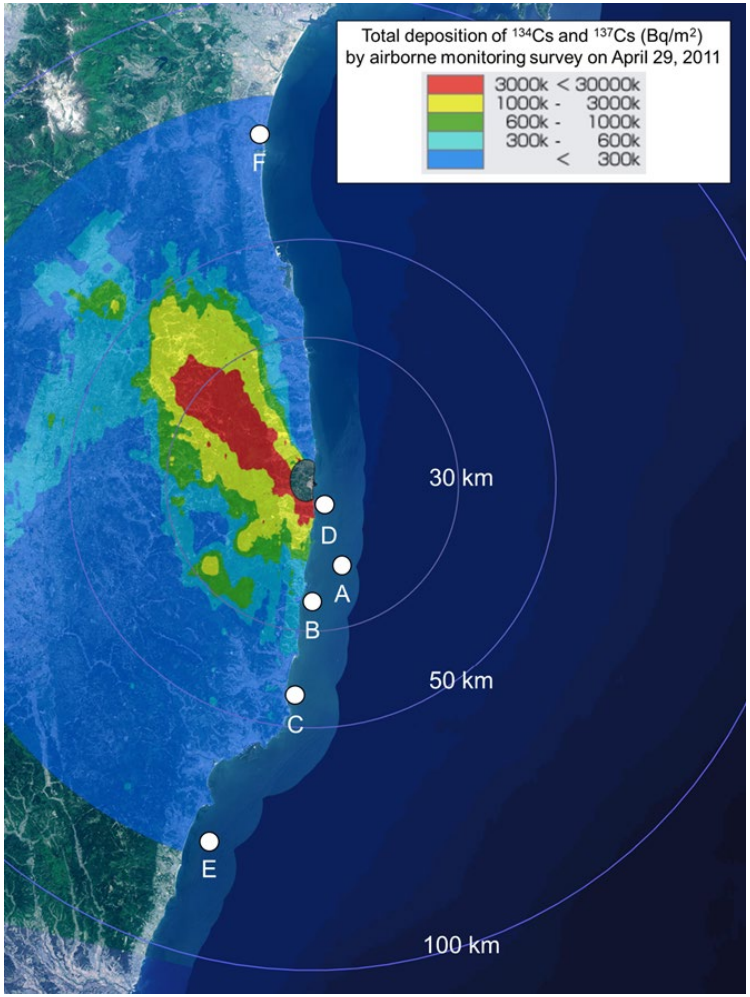
From sediment



Previous → 1 particle/day
This method → 1 particle/hour
(Miura et al., 2018)



Samples



A: filtration
July-2015

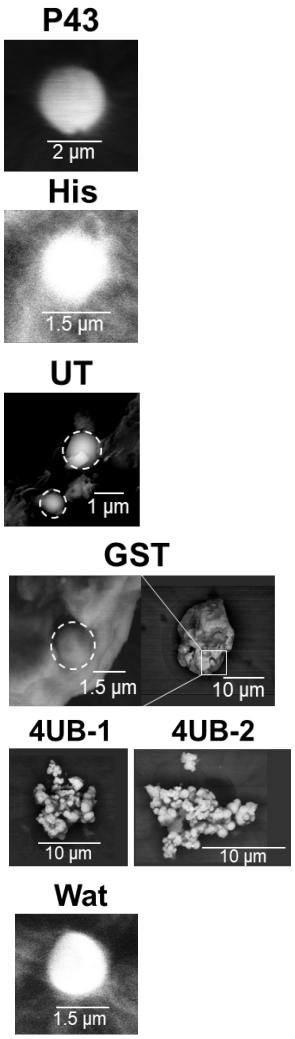
B: filtration
Dec-2013

C: plankton net
July-2011

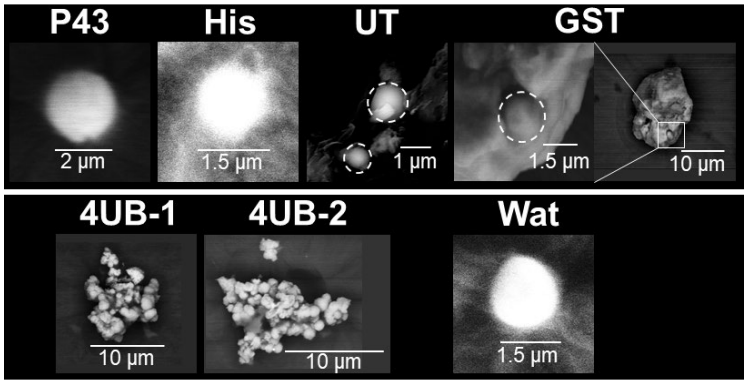
D: sediment trap
Nov-2014

E: sediment core
June-2011

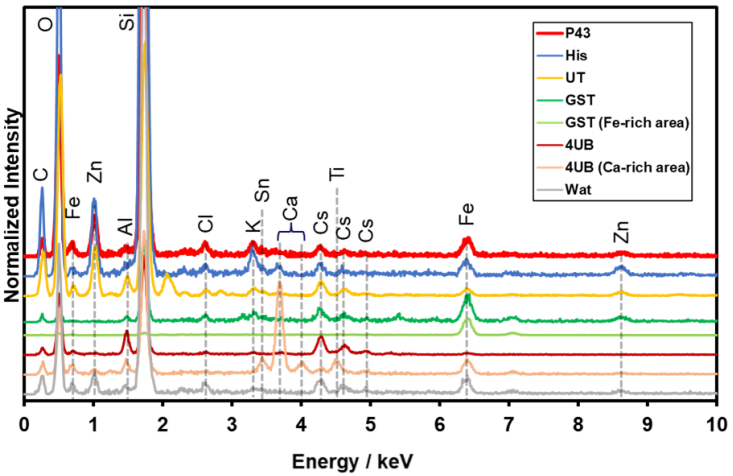
F: filtration
(at estuary)
Nov-2012



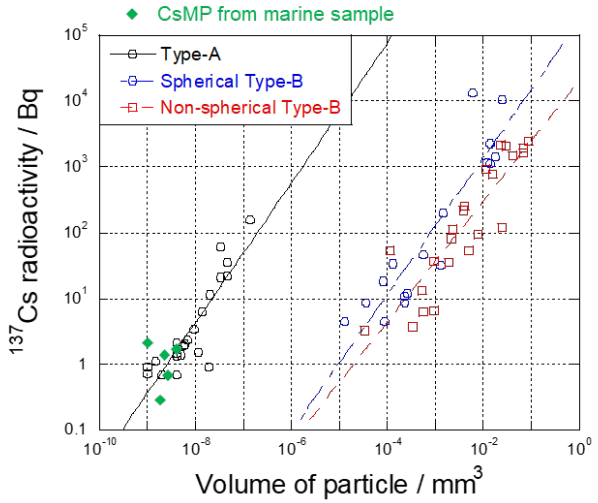
Results



SEM images of CsMPs.



EDS spectra of the CsMPs.



Relationship between ^{137}Cs radioactivity and volume of CsMP.

CsMPs from ocean samples were classified in Type-A pariticles from Unit 2 or 3 of the FDNPP because their size, elemental composition, ^{134}Cs/^{137}Cs and ^{137}Cs radioactivity per volume were similar to those of Type-A particles from terrestrial samples.

Results

Sampling point	Name	Date	Sampling method	$\frac{^{137}\text{Cs in CsMP}}{\text{Total } ^{137}\text{Cs}}$ (%)
A	P-43-I01	2015/7/29	Filtration by large-volume pumps	19.4 –
B	Hisanohama	2013/12/16	Filtration by large-volume pumps	1.80
C	UT06	2011/7/2	Plankton net	77
D	GST#5	2014/11/22	Sediment trap	3.46
E	4UB06-1	2011/6/20	Sediment core	–
F	Watari	2012/11/30	Filtration	24.8

If a sample includes CsMP, K_d value or CF of Cs will be overestimated because Cs in CsMP will be considered as adsorbing to clay minerals or adsorbed by plankton, respectively. Actually, Cs in CsMP is independent on K_d value or CF due to its water-resistance character. When K_d value and CF are discussed, Cs radioactivity of CsMPs should be excluded.

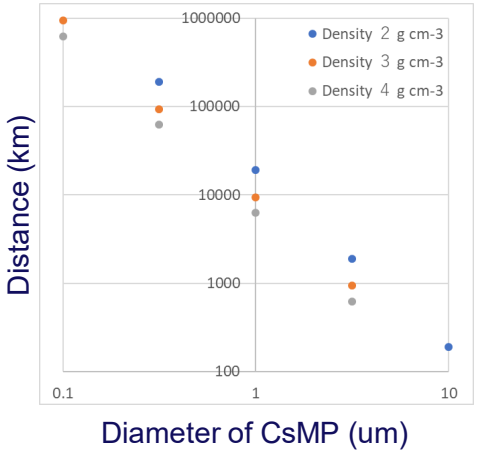
Results

Calculation using stokes' law shows that CsMPs flow ~10,000 km horizontally until they deposit on the seafloor.

Density of CsMP: 3.0-3.5 g cm^{-3}
(calculated using elemental composition cited from Kogure et al. (2016))

Diameter of CsMP: 1 um

Water depth: 100 m



This result suggests that CsMPs flow away after they are transported into the ocean.

However…

CsMPs were collected from suspended particles in coastal area in 2015.

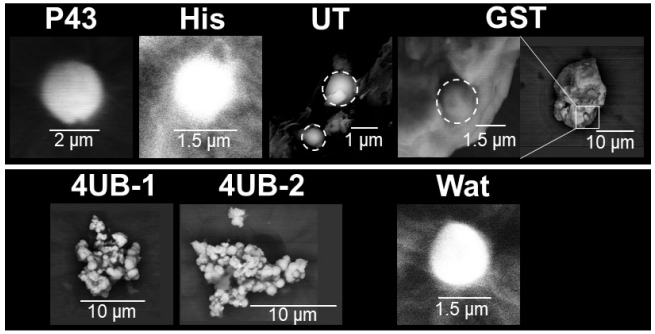
A CsMP was collected from an estuary sample of Abukuma river.

→ (i)CsMPs were continuously supplied from land area to the ocean.
(ii) Rivers are possible sources of CsMPs in the ocean.

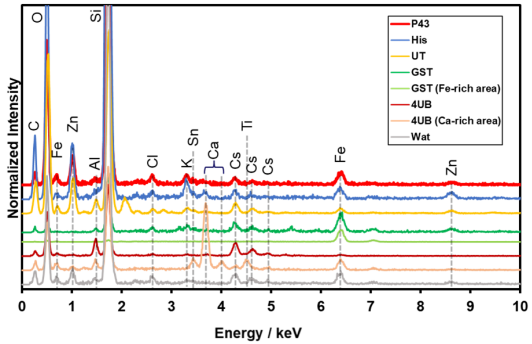
Discovery of radiocesium-bearing microparticles from ocean samples emitted from the Fukushima Daiichi Nuclear Power Plant accident

Hikaru Miura*, Takashi Ishimaru, Yukari Ito, Jota Kanda, Atsushi Kubo, Shigeyoshi Otosaka, Yuichi Kurihara, Daisuke Tsumune, and Yoshio Takahashi

1. CsMPs separated from ocean samples (2011–2015)



SEM images of CsMPs.



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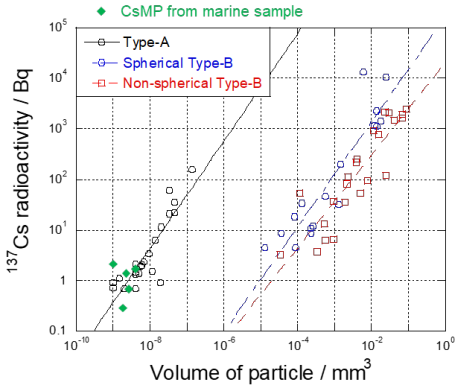

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2. Source of CsMPs (Type-A) from ocean samples

○Calculation using stokes' law shows that CsMPs flow ~10,000 km horizontally until they deposit on the seafloor.

○CsMPs were collected from suspended particles in coastal area in 2015.

○A CsMP was collected from an estuary sample of Abukuma river.

→these results suggests that (i)CsMPs were continuously supplied from land area to the ocean.
(ii) river is possible source of CsMPs in the ocean.