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## MILESTONE MS35

Report of the 2015 Shinsei Maru Research Cruise

KS-15-13

6 October 2015 – 16 October 2015

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(MS3.4) – Report of the 2015 Shinsei Maru Research Cruise

Dissemination level: PU

Date of issue of this report: 16/11/2015

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Dissemination Level		
<b>PU</b>	Public	PU
<b>RE</b>	Restricted to a group specified by the partners of the [COMET] project	
<b>CO</b>	Confidential, only for partners of the [COMET] project	

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## 1 Summary

Researchers of the FRAME (The impact of recent releases from the Fukushima nuclear Accident on the Marine Environment) consortium, within the frame of COMET (COordination and iMplementation of a pan-Europe instrument for radioecology), participated in the 2015 Shinsei Maru “KS-15-13” cruise organized by Japan off Fukushima in October 2015. This cruise was planned as part of the activities programmed to understand the sources, fate, transport, bioaccumulation and associated impact of radionuclides from the Fukushima Dai-ichi NPP accident in Japan. In this report we provide the information regarding the sampling activities conducted during the cruise.

The cruise was carried out from 6 October 2015 (Shiogama) to 16 October 2015 (Yokosuka) and covered the most heavily impacted area, overlapping with where we have sampled in previous years, allowing a time-series of the changing contamination levels. During this 10 days cruise on board the R/V Shinsei Maru offshore from the FDNPP, we collected 124 samples at 19 different stations including 121 seawater samples and 3 sediment cores. Artificial radionuclides will be analyzed in order to determine their fate in the ocean. The natural quartet radium isotopes will also be analyzed to quantify the fluxes of chemical elements associated with the offshore transport. The groundwater sampling attempts to determine the rate of submarine groundwater discharge (SGD) along the Fukushima Prefecture coastline using the natural radium quartet in order to better constrain the cesium flux to the ocean. Groundwater sampling was conducted at 4 private wells, 1 natural spring water, 6 rivers and 4 beaches. 29 samples were collected for radium, cesium and strontium analysis. Samples of marine biota and sinking/suspended particles were also collected. Results will be available during 2016.

## 2 Report of the 2015 Shinaomaru Research Cruise

**KS-15-13**

**6 October 2015 – 16 October 2015**

Woods Hole Oceanographic Institution, US

Universitat Autònoma de Barcelona, Spain

Belgian Nuclear Research Centre SCK-CEN, Belgium

ETH-Zurich, Switzerland

Tokai University, Japan

Fukushima University, Japan

November 2016

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[COMET]

7/18

(MS3.4) – Report of the 2015 Shinsei Maru Research Cruise

Dissemination level: PU

Date of issue of this report: 16/11/2015

Cruise name: R/V Shinsei Maru KS-15-13 research cruise  
Research area: Northwestern North Pacific (off Joban region)  
Period: October 6, 2015 – October 16, 2015  
Departure: Shiogama Port (October 6, 06:00 JST)  
Arrival: Yokosuka Port (October 16, 10:00 JST)  
Calling port: None

Principal Investigator: Shigeyoshi Ootosaka, Ph.D.  
Principal Scientist, Japan Atomic Energy Agency.  
Email: [otosaka.shigeyoshi@jaea.go.jp](mailto:otosaka.shigeyoshi@jaea.go.jp)

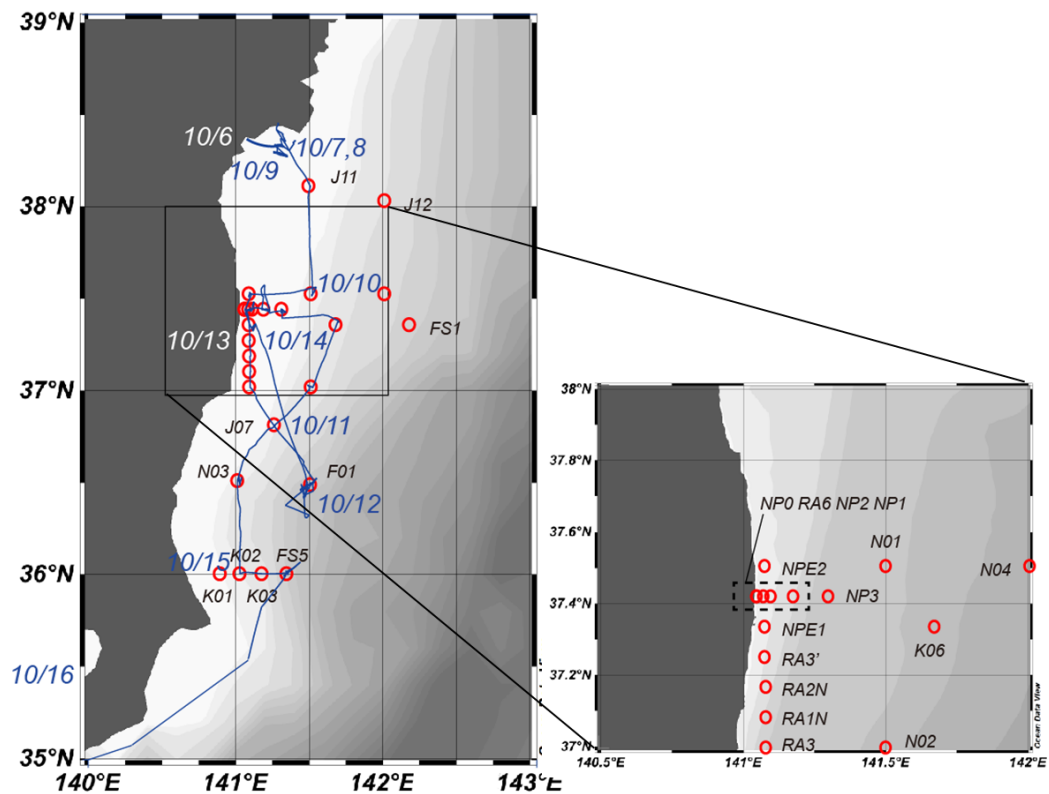
1. Detection of contentious discharge of accident-derived radionuclides to the ocean  
Dr. Shigeyoshi Ootosaka ([otosaka.shigeyoshi@jaea.go.jp](mailto:otosaka.shigeyoshi@jaea.go.jp)): Radioiodine in seawater  
Dr. Ken O. Buesseler ([kbuesseler@whoi.edu](mailto:kbuesseler@whoi.edu)): Ra and Cs isotopes in seawater  
Dr. Hirofumi Tazoe ([tazoe@hirosaki-u.ac.jp](mailto:tazoe@hirosaki-u.ac.jp)): Sr isotopes in seawater  
Dr. Miho Fukuda ([mhfukuda@nirs.go.jp](mailto:mhfukuda@nirs.go.jp)): Radiocesium in seawater  
Dr. Nuria Casacuberta ([ncasacuberta@phys.ethz.ch](mailto:ncasacuberta@phys.ethz.ch)): <sup>236</sup>U in seawater
2. Comprehensive understanding of the bioaccumulation of radionuclides into marine biota  
Prof. Jun Nishikawa ([jun\\_nishikawa@tokai-u.jp](mailto:jun_nishikawa@tokai-u.jp)): Radionuclides in plankton, benthos, micronekton and fishes.
3. Decadal to centennial transport of radionuclides and terrestrial materials  
Dr. Shigeyoshi Ootosaka ([otosaka.shigeyoshi@jaea.go.jp](mailto:otosaka.shigeyoshi@jaea.go.jp)): Radionuclides in seabed sediment  
Dr. Makio C. Honda ([hondam@jamstec.go.jp](mailto:hondam@jamstec.go.jp)): Radionuclides in sinking/suspended particles and observation of mass fluxes

#### Participants onboard

Shigeyoshi Ootosaka (Principal Scientist, Japan Atomic Energy Agency)  
Jun Nishikawa (Professor, Tokai University, Japan)  
Ken O. Buesseler (Senior Scientist, Woods Hole Oceanographic Institution, USA)  
Makio C. Honda (Principal Research Scientist, Japan Agency for Marine Earth Science and Technology)  
Kazuhiko Matsumoto (Research Scientist, Japan Agency for Marine Earth Science and Technology)  
Hirofumi Tazoe (Assistant Professor, Hirosaki University, Japan)  
Mary Grossmann (Researcher, Okinawa Institute of Science and Technology Graduate School, Japan)  
Miho Fukuda (Postdoctoral scientist, National Institute of Radiological Science, Japan)  
Virginie Sanial (Postdoctoral scientist, Woods Hole Oceanographic Institution, USA)  
Xenia Juan Dial (Graduate student, Universitat Autònoma de Barcelona, Spain)  
Yuya Kawai (Undergraduate student, Tokai University, Japan)  
Mayuko Hamana (Undergraduate student, Tokai University, Japan)  
Haruka Kato (Undergraduate student, Tokai University, Japan)  
Yuki Haga (Undergraduate student, Tokai University, Japan)  
Shungo Oshitani (Technician, Marine Work Japan LTD.)



## Cruise track



## Remarks :

Due to rough sea condition, departure date was accelerated to October 6 and evacuated in the Ishinomaki Bay for 3 days. Accordingly, we canceled observations at 5 planned stations (J12, N04, FS1, K01 and K03).

## **1. Overview of the seawater sampling:**

### **Names of Participants:**

**Ken Buesseler**

**Virginie Sanial**

Department of Marine Chemistry and Geochemistry  
Woods Hole Oceanographic Institution (MS #25)  
Woods Hole, MA 02543

**Xenia Juan Diaz**

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**William Jenkins**

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**Pere Masque**

School of Natural Sciences. Edith Cowan University. 270 Joondalup Drive, Joondalup WA 6027. Australia.

and Departament de Física & Institut de Ciència i Tecnologia Ambientals. Universitat Autònoma de Barcelona. 08193 Bellaterra. Spain.

### **List of parameters:**

Radionuclide	T <sub>1/2</sub>
Cesium-134 ( <sup>134</sup> Cs)	2.06 y
Cesium-137 ( <sup>137</sup> Cs)	30.17 y
Strontium-90 ( <sup>90</sup> Sr)	28.9 y
Iodine-129 ( <sup>129</sup> I)	15.7 x 10 <sup>6</sup> y
Tritium ( <sup>3</sup> H)	12.32 y
Radium-223 ( <sup>223</sup> Ra)	11.4 d
Radium-224 ( <sup>224</sup> Ra)	3.66 d
Radium-226 ( <sup>226</sup> Ra)	1602 y
Radium-228 ( <sup>228</sup> Ra)	5.75 y
Uranium-236 ( <sup>236</sup> U)	2.3 x 10 <sup>7</sup> y

**Radium:** 22 seawater samples were collected for radium analysis during the cruise: 20 samples of 400 – 600 L were collected at the surface using a surface pump; 2 samples of 242 L were collected at 5 meters above the bottom using a CTD rosette at the two different visits conducted at station NP0 (10/10/15 and 10/12/15). Seawater was then filtrated through MnO<sub>2</sub> fiber with a flow rate around 1 L/min to allow 100 % of radium fixation. Samples were then processed on board using a Radium Delayed Coincidence Counter (RaDeCC) for <sup>223</sup>Ra and <sup>224</sup>Ra analysis. The analysis of <sup>226</sup>Ra and <sup>228</sup>Ra will be conducted using gamma spectrometers at WHOI.

**Cesium:** 34 seawater samples of ~ 20 L were collected on board for Cs analysis: 30 samples were collected at the surface using a surface pump and 4 samples were collected at 5 m above the bottom at stations NPE1, NPE2 and at the two visits conducted at station NP0. Among all the seawater samples collected, 12 samples were processed on board by adding a Cs carrier and filtration through KNiFC-PAN resin. The processing will be pursued at the laboratory. The <sup>134</sup>Cs and <sup>137</sup>Cs analysis will be conducted using gamma spectrometry at WHOI.

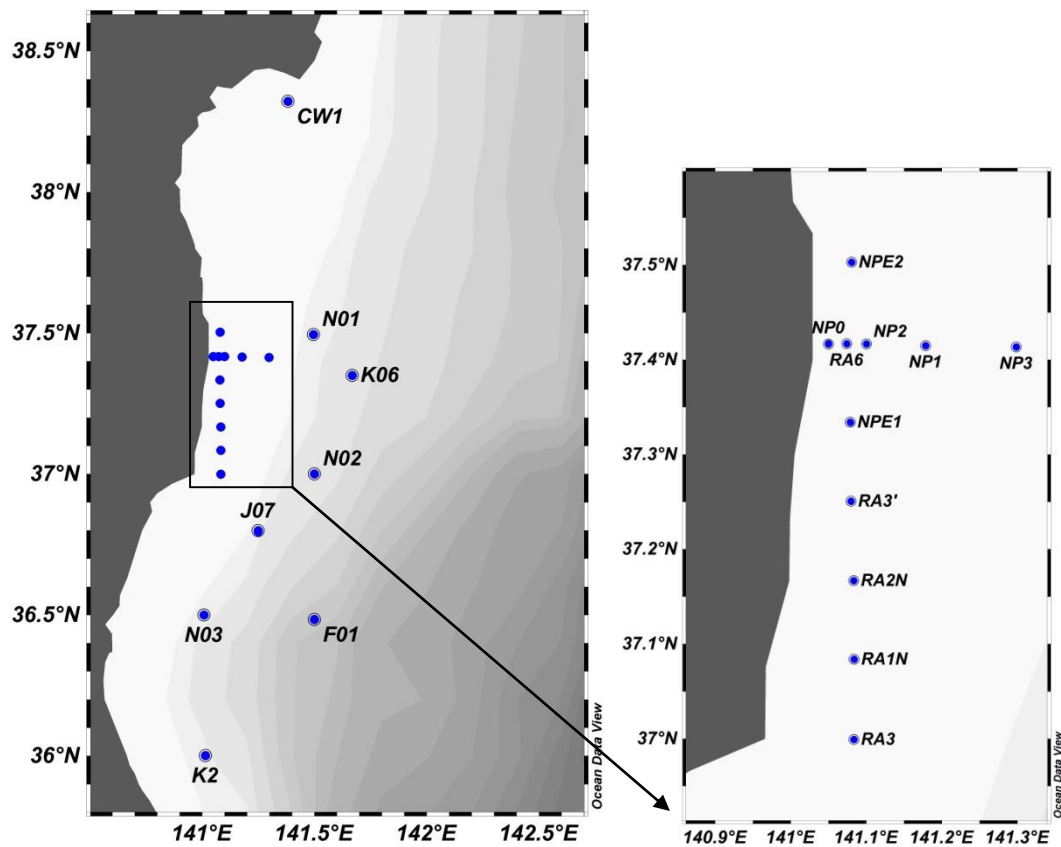
**Strontium:** 22 seawater samples of ~20 L were collected at the surface for Sr analysis. Sr analysis will be performed by Xenia Juan Diaz at WHOI.

**Tritium:** 22 seawater samples of ~1 L were collected at the surface for <sup>3</sup>H analysis. The analysis will be performed by William Jenkins at WHOI.

**Uranium and Iodine:** 24 samples of ~ 5 L were collected for U/I analysis: 22 samples were collected at the surface and 2 samples were collected at 5 m above the bottom at the two visits conducted at station NP0. Seawater samples were then sent to Nuria Casacuberta for analysis.

**Table 1.** *List of samples collected during the #KS-15-13 cruise.*

Sample ID	Station	Depth (m)	Date (GMT)	Latitude (°N)	Longitude (°E)	Samples	Note
F6000	CW1	2	07-oct-15 00:14	38.322	141.383	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6001	CW1	2	07-oct-15 07:45	38.322	141.383	Cs	Surface pumping. Cs processed on board
F6002	J07	219	14-oct-15 06:15	36.799	141.250	Sediment core	Multicore
F6003	N01	2	09-oct-15 13:31	37.495	141.496	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6004	N01	2	09-oct-15 16:30	37.494	141.498	Cs	Surface pumping. Cs processed on board
F6005	NPE2	2	09-oct-15 20:54	37.503	141.081	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6006	NPE2	23	09-oct-15 21:53	37.500	141.079	Cs	CTD. Cs processed on board
F6007	NPE2	2	09-oct-15 23:38	37.503	141.079	Cs	Surface pumping. Cs processed on board
F6008	NP0	2	10-oct-15 02:00	37.417	141.050	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6009	NP0	9.5	10-oct-15 04:33	37.417	141.050	Ra, U/I, Cs	CTD
F6010	NP0	2	10-oct-15 02:50	37.417	141.050	Cs	Surface pumping. Cs processed on board
F6011	NP0	2	10-oct-15 02:55	37.417	141.050	Sediment core	Multicore
F6012	NPE1	2	10-oct-15 03:55	37.334	141.079	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6013	NPE1	22	10-oct-15 03:48	37.334	141.079	Cs	CTD. Cs processed on board
F6014	NPE1	2	10-oct-15 05:50	37.334	141.079	Cs	Surface pumping. Cs processed on board
F6015	F01	2	11-oct-15 00:15	36.484	141.501	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6016	RA3	2	12-oct-15 07:00	36.999	141.084	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6017	RA3	2	12-oct-15 07:05	36.999	141.084	Cs	Surface pumping. Cs processed on board
F6018	RA1N	2	12-oct-15 08:00	37.084	141.084	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6019	RA2N	2	12-oct-15 08:50	37.167	141.083	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6020	RA2N	2	12-oct-15 08:55	37.167	141.083	Cs	Surface pumping. Cs processed on board
F6021	RA3'	2	12-oct-15 09:40	37.251	141.080	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6022	NPE1	2	12-oct-15 10:40	37.334	141.079	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6023	NPE1	2	12-oct-15 10:40	37.334	141.079	Cs	Surface pumping. Cs processed on board
F6024	NP0	2	12-oct-15 11:35	37.417	141.050	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6025	NP0	9.4	12-oct-15 21:40	37.417	141.050	Ra, Cs, I/U	CTD. Cs processed on board
F6026	NP0	2	12-oct-15 19:00	37.417	141.050	Ra, Cs/Sr, 3H, I/U	Surface pumping. Cs processed on board
F6027	RA6	2	12-oct-15 22:20	37.417	141.074	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6028	NP2	2	12-oct-15 23:00	37.417	141.100	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6029	NP1	2	13-oct-15 04:30	37.415	141.179	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6030	NP3	2	13-oct-15 13:15	37.413	141.298	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6031	K06	2	13-oct-15 21:00	37.350	141.668	Cs/Sr, 3H, I/U	Surface pumping
F6032	N02	2	14-oct-15 00:50	37.000	141.500	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6033	J07	2	14-oct-15 05:35	36.796	141.250	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6034	N03	2	14-oct-15 09:00	36.500	141.009	Ra, Cs/Sr, 3H, I/U	Surface pumping
F6035	K2	2	14-oct-15 17:55	36.001	141.015	Cs/Sr, 3H, I/U	Surface pumping
F6043	K2	270	14-oct-15 18:32	36.001	141.015	Sediment core	Multicore



**Figure 1.** Location of stations sampled during the #KS-15-13 cruise.

## **2. Overview of the groundwater sampling:**

### **Names of Participants:**

**Matt Charette**

**Virginie Sanial**

Department of Marine Chemistry and Geochemistry  
Woods Hole Oceanographic Institution (MS #25)  
Woods Hole, MA 02543

**Seiya Nagao**

Institute of Nature and Environmental Technology  
Low Level Radioactivity Laboratory  
Kanazawa University, Japan

### **Other investigators:**

**Ken Buesseler**

Department of Marine Chemistry and Geochemistry  
Woods Hole Oceanographic Institution (MS #25)  
Woods Hole, MA 02543

### **List of parameters:**

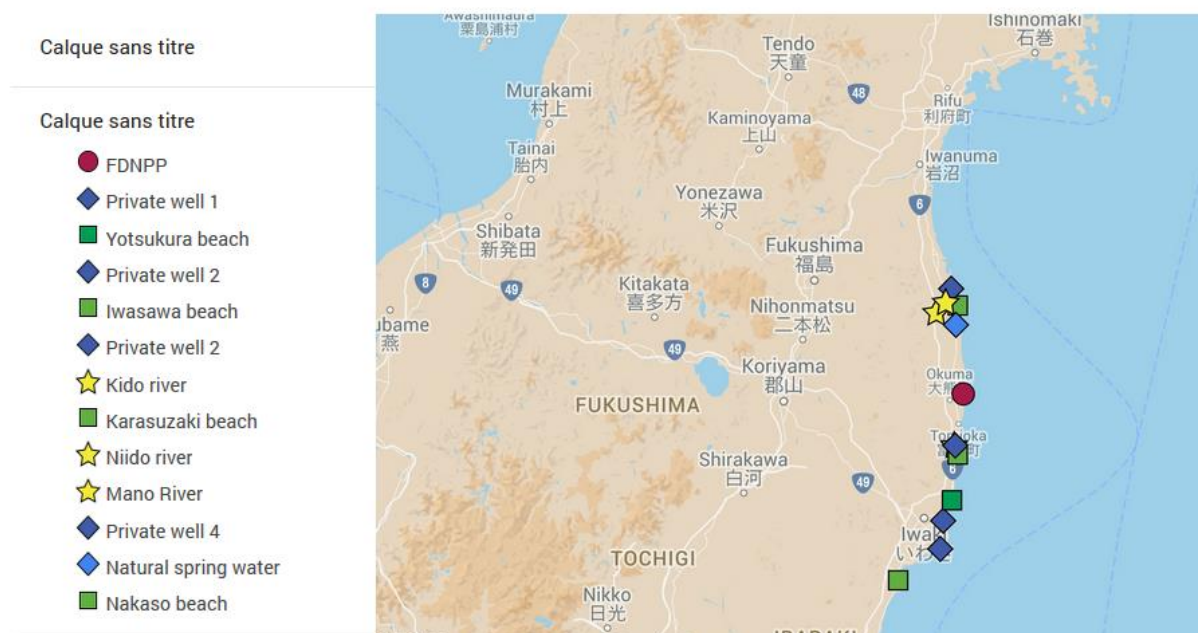
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Cesium-137 ( <sup>137</sup> Cs)	30.17 y
Strontium-90 ( <sup>90</sup> Sr)	28.9 y
Radium-223 ( <sup>223</sup> Ra)	11.4 d
Radium-224 ( <sup>224</sup> Ra)	3.66 d
Radium-226 ( <sup>226</sup> Ra)	1602 y
Radium-228 ( <sup>228</sup> Ra)	5.75 y

Groundwater samples were collected on beaches using push point piezometers. Samples were collected at different salinity concentrations. Water samples were filtrated through MnO<sub>2</sub> fiber to pre-concentrate radium. Water was then stored in cubis for cesium and strontium analysis. Radium analysis was performed in all groundwater samples using RaDeCC systems. Cesium analysis in river samples will be performed by Professor Seiya Nagao. Cesium and strontium analysis in well and beach samples will be performed at WHOI.

**Table 2:** *List of groundwater samples collected during the field trip*

Sample ID	Location	Date (GMT)	Latitude (°N)	Longitude (°E)
F6036	Private well 1	18-oct-15 00:20	36.960	140.948
F6037	Yotsukura beach	18-oct-15 01:43	37.104	140.992
F6038	Yotsukura beach	18-oct-15 02:20	37.104	140.992
F6039	Yotsukura beach	18-oct-15 02:54	37.104	140.992
F6040	Yotsukura beach - Seawater	18-oct-15 02:05	37.104	140.992
F6041	Private well 2	18-oct-15 04:20	37.044	140.959
F6042	Natsui River	18-oct-15 01:00	37.671	140.881
F6044	Iwasawa Beach	19-oct-15 02:38	37.241	141.013
F6045	Iwasawa Beach	19-oct-15 01:27	37.241	141.013
F6046	Iwasawa Beach - Seawater	19-oct-15 01:43	37.241	141.013
F6047	Iwasawa Beach	19-oct-15 02:33	37.241	141.013
F6048	Iwasawa Beach	19-oct-15 02:38	37.241	141.013
F6049	Iwasawa River	19-oct-15 02:25	37.241	141.012
F6050	Private well 3	19-oct-15 05:05	37.270	141.004
F6051	Kido River	19-oct-15 01:35	37.272	141.000
F6052	Karasuzaki beach	20-oct-15 01:56	37.686	141.013
F6053	Karasuzaki beach	20-oct-15 02:23	37.686	141.013
F6054	Karasuzaki beach - Seawater	20-oct-15 02:30	37.686	141.013
F6055	Karasuzaki beach	20-oct-15 03:10	37.685	141.013
F6056	Karasuzaki beach	20-oct-12 03:40	37.685	141.013
F6057	Niido River	20-oct-15 02:30	37.698	140.969
F6058	Mano River	20-oct-15 01:00	37.668	140.932
F6059	Private well 4	20-oct-15 05:15	37.737	140.989
F6060	Natural spring water	20-oct-15 05:53	37.630	141.007
F6061	Nakaso beach - Seawater	22-oct-15 00:54	36.864	140.790
F6062	Nakaso beach	22-oct-15 01:22	36.864	140.790
F6063	Nakaso beach	22-oct-15 01:33	36.864	140.790
F6064	Nakaso beach	22-oct-15 02:09	36.864	140.790
F6065	Same River @ Nakaso beach	22-oct-15 00:50		

# Groundwater sampling Oct 16- Oct 22 2015



**Figure 2:** *Locations of groundwater samples*



### **3. Overview of the seabed sediment sampling (multiple coring):**

**Table 3.** *List of sediment samples collected during the field trip*

Station	Location	Bottom depth (m)	Collection date (GMT)
J11'	38°04.78'N, 141°29.21'E	118	10/09 09:49
NP0*	37°25.02'N, 141°03.01'E	16	10/10 02:33
F01	36°29.13'N, 141°30.21'E	1321	10/12 02:36
NP2*	37°25.03'N, 141°05.98'E	30	10/13 03:00
NP1*	37°25.00'N, 141°10.70'E	58	10/13 09:59
NP3*	37°24.89'N, 141°17.89'N	120	10/13 16:27
K06	37°20.99'N, 141°40.11'N	297	10/13 21:57
J07	36°47.92'N, 141°15.00'N	219	10/14 06:15
N03	36°30.03'N, 140°59.99'N	301	10/14 14:16
K02	36°00.00'N, 141°01.00'N	270	10/14 18:32
FS5	36°00.00'N, 141°19.99'N	1165	10/15 04:21

### **4. Overview of the plankton, micronekton and fish sampling:**

**Table 4.** *List of sediment samples collected during the field trip*

Station	Location	Collection date (GMT)
N01	37°30.00'N, 141°30.00'E	2015/10/09 14:19
NPE2	37°30.00N, 141°04.80E	2015/10/09 21:35
NPE1	37°20.00N, 141°04.80E	2015/10/10 04:09
F01	36°28.50N, 141°18.70E	2015/10/11 01:51
NP0	37°25.00N, 141°03.00E	2015/10/12 12:06
NP2	37°25.00N, 141°06.00E	2015/10/12 23:32
NP1	37°25.00N, 141°10.70E	2015/10/13 05:08
NP3	37°25.00N, 141°18.00E	2015/10/13 13:52
N02	37°00.00N, 141°30.00E	2015/10/14 01:29
N03	36°30.00N, 141°00.00E	2015/10/14 09:54
FS5	36°00.00N, 141°20.00E	2015/10/15 00:20

## **5. Overview of the sinking particles sampling:**

**Table 5.** *List of sediment samples collected during the field trip*

Sinking particles were collected using time-series sediment traps. A mooring array was retrieved and deployed during this cruise.

Station: F01

Retrieval location: 36°28.5297'N / 141°28.6773'E (2015/10/11 06:00-07:30)

Deployed location: 36°28.7229'N / 141°29.0343'E (2015/10/12 09:00-10:30)

Expected period of collection of sinking particles:

500 m: 2015/10/14 00:00 ~ 2016/12/29 00:00:00

1000 m: 2015/10/14 00:00 ~ 2016/10/5 00:00:00