



Yokosuka Cruise Report YK24-16C

In situ biodegradability tests of newly developed
biodegradable materials and investigations on their
controlling factors

Sagami Bay, western North Pacific abyssal plain

18th Oct -6th Nov, 2024

Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

1. Cruise Information

- Cruise ID

YK24-16C

- Name of vessel

Yokosuka

- Title of project

In situ biodegradability tests on newly developed biodegradable materials and investigations on their controlling factors

- Title of cruise

In situ biodegradability tests on newly developed biodegradable materials and investigations on their controlling factors

- Chief Scientist [Affiliation]

Hidetaka Nomaki [JAMSTEC]/Hiroyuki Kashima [JAMSTEC]

- Cruise period

18th Oct to 6th Nov, 2024

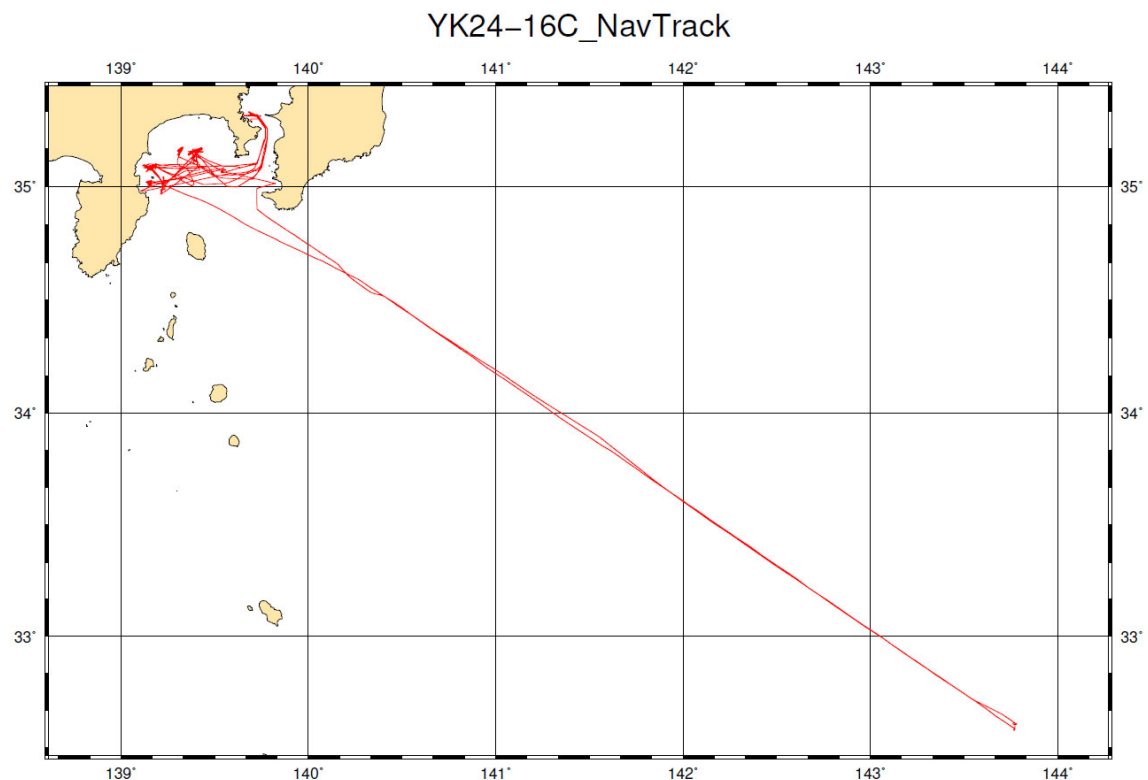
- Ports of departure / call / arrival

New Yokosuka port/Yokosuka No.4 Area/JAMSTEC

- Research area

Sagami Bay, western North Pacific abyssal plain

- Research map



2. Research Proposal and Science Party

- Title of proposal

In situ biodegradability tests on newly developed biodegradable materials and investigations on their controlling factors

- Representative of Science Party [Affiliation]

Hidetaka NOMAKI¹ [Japan Agency for Marine-Earth Science and Technology]

● Science Party (List) [Affiliation, assignment etc.]

Hiroyuki KASHIMA ²	[JAMSTEC]
Yuto KAKU	[JAMSTEC]
Yoshiyuki ISHITANI ¹	[JAMSTEC]
Chong CHEN ¹	[JAMSTEC]
James FLEMMING ¹	[JAMSTEC]
Takuma SUZUKI ¹	[JAMSTEC]
Mio MATSUMOTO ¹	[JAMSTEC/Soukendai]
Maki KAYAMORI ¹	[JAMSTEC/The University of Tokyo]
Keiko TANAKA ²	[JAMSTEC]
Sachiko KAWADA ²	[JAMSTEC]
Asahi MAEDA ²	[JAMSTEC/Kyoto University]
Soulenthone PHOUVILAY ¹	[Gunma Univ.]
Tomoya SUZUKI ¹	[Gunma Univ.]
Tsukuru TSUKUI ¹	[Gunma Univ.]
Jun KATAOKA ¹	[Gunma Univ.]
Taizo KABE ²	[The University of Tokyo]
Hisanori IWAMOTO	[NME]
Kohei IKEDA	[NME]
1: 18 th Oct – 29 th Oct	
2: 30 th Oct – 6 th Nov	

YOKOSUKA Crew List

Captain	AOKI Takafumi
Chief Officer	YAMAGUCHI Ryo
2nd Officer	KUSUMI Keisuke
3rd Officer	OBATA Yuto
Jr.3rd Officer	SAKAMOTO Rindo
Chief Engineer	TSUKADA Minoru
1st Engineer	GIBU Daisuke
2nd Engineer	TOMIYAMA Yusuke
3rd Engineer	SHIMIZU Koki
Jr.3rd Engineer	FURUYAMA Yuji
Chief Electronic Op.	MABARA Takayuki
2nd Electronic Op.	ONIKUBO Ryuji
BoatSwain	IWASAKI Naoki
Quarter Master	ISHIZUKA Nao
Quarter Master	HONJO Hotaka
Quarter Master	KOJIMA Shinya
Sailor	NAKANISHI Ryo
Sailor	TANAKA Taisei
Sailor	MATSUDA Taisei
No.1 Oiler	HIGASHIGAWA Yuji
Oiler	SATO Daiki
Oiler	HIDAKA Toru
Assistant Oiler	MATSUMURA Kota
Assistant Oiler	OCHIAI Kenzo
Chief Steward	MURAKAMI Toru
Steward	ASANO Toshiyuki
Steward	SUZUKI Kentaro
Steward	NAKANO Mizuki
Steward	SATO Keito

Shinkai 6500 operating team

Submersible Operation Manager	CHIBA Kazuhiro
Deputy Submersible Operation Manager	ISHIKAWA Akihisa
1st Submersible Staff	UEKI Mitsuhiro
1st Submersible Staff	SAITO Fumitaka
1st Submersible Staff	ONISHI Takuma
2nd Submersible Staff	UEKI Hirofumi
2nd Submersible Staff	SUZUKI Keigo
2nd Submersible Staff	IJJIMA Satsuki
2nd Submersible Staff	MATSUSAKA Motohiro
3rd Submersible Staff	ICHINOSE Daiki
3rd Submersible Staff	SATO Kaisei
3rd Submersible Staff	EDA Tomoka

3. Research/Development Activities

3.1. *In situ* biodegradability tests of different types of novel plastics on the deep-sea floor

3.1.1. Objectives

Mismanagement of plastic wastes provoke leakage into the ocean and subsequent serious damages on marine ecosystems. Moreover, extreme weather events such as heavy rainfall and stormy wind remarkably intensifies the chances and amounts of plastic leakage into the ocean. Therefore, even under the proper management of plastic wastes, accidental releases by natural disasters such as extreme weather events and tsunamis are unavoidable. Once released into the ocean, plastic debris is assumed to remain in the marine environment for more than several hundred years. Part of them starts to sink because of their high specific weights in the seawater or increasing negative buoyancy due to biofouling or attachments of sediment particles. Eventually, the deep-sea floor that covers over 60% of the Earth's surface is a potential sink for plastic debris and our earlier observations confirmed the accumulation of single-use plastics even deeper than 5,000 m of water depth. To circumvent undesired accumulations of single-use plastics on the deep-sea floor, the conventional single-use plastics need to be replaced with the materials that can degrade on the deep-sea floor, such as biodegradable plastic. However, the degradation of conventional biodegradable plastics such as polylactic acid (PLA) requires the "compostable" condition: the temperature must be higher than 40°C. This requirement does not match the marine environment, especially the deep-sea floor, i.e. low temperature, high water pressure, no sunlight penetration, and low biological activity, is still unclear. Hence, the development of materials that degrade under such deep-sea condition is in urgent need.

In this context, we launched a collaborative Moonshot project with Gunma University, University of Tokyo, Tokyo Institute of Technology, and RIKEN financially supported by New Energy and Industrial Technology Development Organization (NEDO). Herein, more than 100 types of novel bio-degradable materials developed by above mentioned research institutes and universities as well as collaborating private companies are subjected to the *in situ* degrading test on the deep-sea floor.

3.1.2. Methods

More than 100 types of novel bio-degradable materials were stored in the deployed sample chamber. The chambers have been deployed on the deep-sea floor off Hatsushima and off Misaki of Sagami Bay, and west of KEO. The biodegradable plastic chambers deployed at Myojin-Knoll has successfully been recovered. We recovered some materials that have been deployed in the previous cruises and examine the degradation state of them. We also collected "natural" plastic debris, sediment, seawater, and organisms.

3.1.3. Results & findings in this cruise

The samples were deployed/recovered successfully, and the physicochemical measurements were performed using seawater and sediment samples. Plastic debris, sunken plants, and organism samples were collected and processed for subsequent analyses.

3.1.4. Future plan

The deployed samples will be recovered 6 months or 1 year later. The recovered samples will be scrutinized to find out a clue for the deep-sea degradable materials. In addition, the microorganisms attaching on the plastics surface will be analyzed.

3.2. Geochemical measurements and biological analyses

3.2.1. Objectives

Geochemical conditions of the bottom water and in the sediments significantly effect on degradability of biodegradable plastics. Furthermore, compositions of prokaryotes, eukaryotic microbes, and metazoans and their metabolic pathways/activities control the biodegradability on the deep-sea floor. We thus measured the geochemical conditions of the bottom water and porewater in sediments using several different analytical methods. We also collected sediments, water, debris, and megabenthos to investigate biological parameters.

3.2.2. Materials and Methods

We collected bottom water and sediment cores using a push corer. After recovery onboard, we extracted porewater from the sediments by using a centrifuging machine. The surface sediments were further sampled for prokaryotic and eukaryotic microbial analyses.

Visible megabenthos were collected using a scoop or a suction sampler and were fixed with either EtOH, formaldehyde, or deep-frozen. Deep-sea debris were also collected with the *Shinkai6500* to examine the microbiome and their novel enzyme of the debris surface. They were subsampled onboard and fixed with formaldehyde, deep-frozen, and some were also preserved in a refrigerator for the isolation of biodegrading microbes in the laboratory on land.

3.2.3. Onboard results and future research

Onboard preliminary analyses of chemical parameters of water showed unique characteristics depending on geological and oceanographic settings. The microbial and metazoans analyses will be performed on land.

○ 4. Cruise Log

日付 Date	時間 Local Time	内容 Note	特記事項 Description	本船位置／気象／海象 Position/Weather/ Wind/Sea condition
18-Oct-24	08:00	Scientists onboarded.		12:00 (UTC+9h)
	08:30-08:50	Scientists meeting.		35-04.0N,139-32.5E
	09:00	Let go all share line and left JAMSTEC for research area.		Sagami-wan bay
	09:00-09:20	Scientists meeting.		Weather:c
	09:30-10:10	Carried out education and training for scientists.		Wind:North-4
	10:42	Released XBT.		Wave scale:3
	12:56	Hoisted up "SHINKAI6500".		Swell scale:1
	13:04	Launched "SHINKAI6500".		Visibly: 8'
	13:11	"SHINKAI6500" dove, and started her operation dive No.1821.		
	13:43	"SHINKAI6500" landed the sea bottom.	D=760m	
	16:20	"SHINKAI6500" left the sea bottom.	D=753m	
	16:39	Refloated "SHINKAI6500"		
	17:07	Recovered "SHINKAI6500",and finished above operation.		
	19:00-19:15	Scientists meeting.		
19-Oct-24	08:46	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	08:53	Launched "SHINKAI6500".		35-01.0N,139-13.6E
	09:00	"SHINKAI6500" dove, and started her operation dive No.1822.		Off hatsushima
	09:38	"SHINKAI6500" landed the sea bottom.	D=950m	Weather:bc
	14:43	"SHINKAI6500" left the sea bottom.	D=835m	Wind:WSW-6
	15:02	Refloated "SHINKAI6500"		Wave scale:3
	15:30	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:20	Scientists meeting.		Visibly: 8'

20-Oct-24	09:00-09:20	6K team and scientists meeting.		12:00 (UTC+9h)
	09:15	Let go anchor off Yokosuka No.4.		35-19.5N,139-41.3E
	09:30-10:10	6K briefing.		Off Yokosuka No.4
	18:00-18:20	Scientists meeting.		Weather:bc
				Wind:NE-6
				Wave scale:4
				Swell scale:1
				Visibly: 8'
21-Oct-24	09:40	Heave anchor, proceeded to research area.		12:00 (UTC+9h)
	18:00-18:10	Scientists meeting.		35-00.5N,139-25.0E
				Southwest of Jyogashima
				Weather:bc
				Wind:NNE-6
				Wave scale:4
				Swell scale:1
				Visibly: 8'
22-Oct-24	08:48	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	08:54	Launched "SHINKAI6500".		35-00.8N,139-13.3E
	09:01	"SHINKAI6500" dove, and started her operation dive No.1823.		Sagami-wan bay
	09:38	"SHINKAI6500" landed the sea bottom.	D=1,018m	Weather:bc
	15:40	"SHINKAI6500" left the sea bottom.	D=810m	Wind:NNE-5
	15:58	Refloated "SHINKAI6500"		Wave scale:3
	16:23	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:10	Scientists meeting.		Visibly: 8'
23-Oct-24		Transit to west of KEO.		12:00 (UTC+9h)
	18:00-18:10	Scientists meeting.		34-03.5N,141-12.6E
				Off east of Miyakejima
				Weather:bc
				Wind:SSE-5
				Wave scale:3
				Swell scale:3
				Visibly: 8'
24-Oct-24	06:10	Released XBT.		12:00 (UTC+9h)
	08:47	Hoisted up "SHINKAI6500".		32-34.9N,143-46.2E
	08:53	Launched "SHINKAI6500".		West of KEO
	09:00	"SHINKAI6500" dove, and started her operation dive No.1824.		Weather:bc
	11:33	"SHINKAI6500" landed the sea bottom.	D=5,502m	Wind:SW-3
	13:51	"SHINKAI6500" left the sea bottom.	D=5,506m	Wave scale:2
	15:53	Refloated "SHINKAI6500"		Swell scale:3
	16:18	Recovered "SHINKAI6500",and finished above operation.		Visibly: 8'
	17:03-17:22	Eight fugure turns.		
	19:00-19:10	Scientists meeting.		

25-Oct-24	11:15	Let go anchor Tateyama-wan bay.		12:00 (UTC+9h)
	18:00-18:10	Scientists meeting.		35-01.0N,139-49.4E
				Tateyama-wan bay
				Weather:o
				Wind:NNE-3
				Wave scale:1
				Swell scale:0
				Visibly: 8'
26-Oct-24	09:44	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	09:50	Launched "SHINKAI6500".		35-04.1N,139-32.4E
	09:57	"SHINKAI6500" dove, and started her operation dive No.1825.		Off Misaki
	10:39	"SHINKAI6500" landed the sea bottom.	D=763m	Weather:o
	14:41	"SHINKAI6500" left the sea bottom.	D=775m	Wind:NNE-4
	15:00	Refloated "SHINKAI6500"		Wave scale:3
	15:28	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:10	Scientists meeting.		Visibly: 7'
27-Oct-24	08:47	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	08:54	Launched "SHINKAI6500".		35-00.8N,139-13.3E
	09:01	"SHINKAI6500" dove, and started her operation dive No.1826.		Off hatsushima
	09:38	"SHINKAI6500" landed the sea bottom.	D=1,073m	Weather:o
	14:59	"SHINKAI6500" left the sea bottom.	D=801m	Wind:North-2
	15:17	Refloated "SHINKAI6500"		Wave scale:1
	15:45	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:10	Scientists meeting.		Visibly: 8'
28-Oct-24	08:30-08:40	Scientists meeting.		12:00 (UTC+9h)
	09:53	Hoisted up "SHINKAI6500".		35-00.3N,139-22.4E
	10:00	Launched "SHINKAI6500".		Central Sagami-wan bay
	10:07	"SHINKAI6500" dove, and started her operation dive No.1827.		Weather:r
	10:56	"SHINKAI6500" landed the sea bottom.	D=1,400m	Wind:NE-2
	15:27	"SHINKAI6500" left the sea bottom.	D=1,395m	Wave scale:2
	16:00	Refloated "SHINKAI6500"		Swell scale:1
	16:25	Recovered "SHINKAI6500",and finished above operation.		Visibly: 8'
	19:00-19:30	Scientists meeting.		
29-Oct-24	10:00	Arrived at JAMSTEC		12:00 (UTC+9h)
		Former scientists disembarked.		At JAMSTEC
30-Oct-24	10:00	Latter scientists embarked.		12:00 (UTC+9h)
	10:00-10:20	Scientists meeting.		At JAMSTEC
	10:30-10:50	Carried out education and training for scientists.		
	13:00-13:25	6K team and scientists meeting.		
	14:00	Let go all share line and left JAMSTEC for research area.		
	18:00-18:15	Scientists meeting.		

31-Oct-24	09:51	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	10:00	Launched "SHINKAI6500".		35-04.1N,139-32.3E
	10:07	"SHINKAI6500" dove, and started her operation dive No.1828.		Off Misaki
	10:37	"SHINKAI6500" landed the sea bottom.	D=762m	Weather:bc
	14:46	"SHINKAI6500" left the sea bottom.	D=760m	Wind:NE-2
	15:04	Refloated "SHINKAI6500"		Wave scale:2
	15:28	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:20	Scientists meeting.		Visibly: 8'
01-Nov-24	09:45	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	09:52	Launched "SHINKAI6500".		35-00.8N,139-13.3E
	09:59	"SHINKAI6500" dove, and started her operation dive No.1829.		Off Hatsushima
	10:37	"SHINKAI6500" landed the sea bottom.	D=1,134m	Weather:bc
	15:31	"SHINKAI6500" left the sea bottom.	D=868m	Wind:NE-2
	15:50	Refloated "SHINKAI6500"		Wave scale:1
	16:15	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	17:20	Let go anchor off Ito-ko port.		Visibly: 8'
	19:00-19:15	Scienitsts meeting.		
02-Nov-24	08:10	Heave anchor, proceeded to Yokosuka No.4.		12:00 (UTC+9h)
	11:45	Let go anchor Yokosuka No.4.		35-19.8N,139-41.0E
	18:00-18:15	Scientists meeting.		Yokosuka No.4
				Weather:r
				Wind:ENE-4
				Wave scale:2
				Swell scale:1
				Visibly: 6'
03-Nov-24	10:10	Heave anchor, proceeded to research area.		12:00 (UTC+9h)
	18:00-18:10	Scientists meeting.		35-05.5N,139-28.2E
				Off southeast of Jyogashima
				Weather:bc
				Wind:NE-6
				Wave scale:3
				Swell scale:1
				Visibly: 8'
04-Nov-24	09:52	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	09:59	Launched "SHINKAI6500".		35-00.2N,139-13.5E
	10:05	"SHINKAI6500" dove, and started her operation dive No.1830.		Off Hatsushima
	10:48	"SHINKAI6500" landed the sea bottom.	D=1,204m	Weather:bc
	15:37	"SHINKAI6500" left the sea bottom.	D=1,055m	Wind:South-4
	16:01	Refloated "SHINKAI6500"		Wave scale:2
	16:28	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:15	Scientists meeting.		Visibly: 8'

05-Nov-24	09:48	Hoisted up "SHINKAI6500".		12:00 (UTC+9h)
	09:55	Launched "SHINKAI6500".		34-59.5N,139-13.2E
	10:02	"SHINKAI6500" dove, and started her operation dive No.1831.		Nankai trough
	10:48	"SHINKAI6500" landed the sea bottom.	D=1,167m	Weather:o
	15:31	"SHINKAI6500" left the sea bottom.	D=993m	Wind:NE-5
	15:54	Refloated "SHINKAI6500"		Wave scale:3
	16:19	Recovered "SHINKAI6500",and finished above operation.		Swell scale:1
	19:00-19:20	Scientists meeting.		Visibly: 8'
06-Nov-24	09:00	Arrived at JAMSTEC Yokosuka. Finished YK24-17C cruise.		
	11:00	All scientists disembarked.		

● 5. Notice on Using

This cruise report is a preliminary documentation as of the end of cruise.

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

Users of information on this report are requested to submit Publication Report to JAMSTEC.

<http://www.godac.jamstec.go.jp/darwin/explain/1/e#report>

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