

## Annual activity report of oceanographic observations by the T/V *Kagoshima-maru*

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**Key words:** oceanographic observation, CTD, MOCNESS, VMPS

### Abstract

In order to facilitate the effective use of the training Vessel *Kagoshima-maru*, we report the annual activity of oceanographic observations and sample collections made by this ship during the academic year 2014 (April 2014 to March 2015). The T/V *Kagoshima-maru* conducted a total of 23 cruises over the western North Pacific Ocean, East China Sea and their adjacent waters during 152 cruise days in this academic year. The total number of participants reached 644, which included 231 persons from ten universities that used this ship under the Joint-use Educational Facility system.

### Introduction

The *Kagoshima-maru*, which belongs to the Faculty of Fisheries, Kagoshima University, was constructed in March 2012 as a middle-scale training vessel available to conduct long-term, long-range, multipurpose research cruises over the subtropical and tropical area of the North Pacific Oceans.

This ship was certified as a Joint-use Educational Facility by the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT) in 2010. Utilizing this system since 2010, various universities that do not possess their own training vessels have used the T/V *Kagoshima-maru* under collaboration with our Faculty or on their own use. In the academic year 2014, a total of ten universities have used the T/V *Kagoshima-maru* under this joint-use system. In order to promote this joint-use system, we here report an annual summary of oceanographic observations and sample collections carried out during the academic year 2014 (April 2014 to March 2015) by the T/V *Kagoshima-maru*.

### Specifications and operations of shipboard instruments

This section provides general information on specifications and operating procedures of shipboard

instruments that were used for oceanographic observations and sample collections in the academic year 2014. Details of the information will be found at the publications listed below.

A Conductivity-Temperature-Depth Profiler System with a 24-position Carousel Multiple Sampler (CTD-CMS) was used for hydrographic observations using the sensors for conductivity, temperature and pressure (SBE 9plus: Sea-Bird Electronics, Inc.), dissolved oxygen (SBE45: Sea-Bird Electronics, Inc.), altimeter (Benthos PSA-916D: Teledyne Benthos, Inc.), fluorescence (ECO-FL: WET Labs, Inc.), and PAR (QSP-2300L: Biospherical Instruments, Inc.). Occasionally, the eXpendable Bathythermograph System (XBT T-5 and T-7 probes with a digital converter TS-MK130 and a hand-held launcher LM-3A: Tsurumi-Seiki-Kosakusho Co., Ltd) were used for recording the vertical profile of water temperature during cruises (Note that eXpendable CTD probes are also available for this system). Optionally, a Fast Repetition Rate Fluorescence (FRRF: Kimoto Electric Co., Ltd.) was attached with a CMS flame to measure the physiological activity of the phytoplankton community. Several 12-liter X-Niskin Bottles attached

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with CMS were used for collecting seawater. Occasionally, seawater samples were collected by normal Niskin or GO-FLO bottles attached to a wire at the desired depths. These bottles were closed by messengers. CTD-CMS, Niskin and GO-FLO were deployed from starboard on the working deck.

For monitoring bathymetry and underwater substrates, the T/V *Kagoshima-maru* has two different sonar instruments, an Acoustic Doppler Current Profiler (Ocean Surveyor ADCP: Teledyne-RD Instruments, Inc.) and a Scientific Echo Sounder (EK60: Simrad). Available working frequencies were 75 kHz for the Acoustic Doppler Current Profiler (ADCP) and 12, 38, 120 and 200 kHz for the Scientific Echo Sounder (SES). ADCP and SES were used for measuring water current velocities over a depth range and for monitoring bathymetry and underwater substrate classification, respectively.

A Vertical Multiple-opening Plankton Sampler (VMPS: Tsurumi-Seiki-Kosakusho Co., Ltd), was employed during hydrographic observations using the sensors for conductivity, temperature and pressure (SBE 52MP: Sea-Bird Electronics Inc.) and fluorescence (ECO FLNTU(RT)D: WET Labs, Inc.) and collecting depth-stratified zooplankton samples. The mouth opening was 0.25 m<sup>2</sup>. Four multiple nets were attached and two different mesh openings (0.1 mm and 0.064 mm) were used. A flow meter (Rigo Co., Ltd) was mounted in the mouth of the frame to register the volume of water that passed through the net. The VMPS was deployed from starboard on the working deck.

A Multiple Opening Closing Net and Environmental Sensing System (MOCNESS: Biological Environmental Sampling System, Inc.) were used for collecting depth-stratified zooplankton samples during the cruises. The mouth opening was 4 m<sup>2</sup>. Six multiple nets were attached and two different mesh openings (0.335 mm and 0.125 inch) were used. The sensors were for conductivity, temperature and pressure (Sea-Bird Electronics, Inc.), altimeter (Teledyne Benthos, Inc.), and fluorescence (WET Labs, Inc.). A flow meter (Tsurumi-Seiki-Kosakusho Co., Ltd) was mounted in the mouth of the frame to register the volume of water that passed through the net. MOCNESS was deployed from the rear on the working deck.

A North Pacific Standard (NORPAC) net was used for collecting zooplankton samples during the cruises. The mouth diameter was 0.45 m. The two different mesh

openings used were 0.1 mm and 0.335 mm, respectively. A flow meter (Rigo Co., Ltd) was mounted in the mouth of the frame to register the volume of water that passed through the net. NORPAC was deployed from starboard on the working deck.

A Larval net (LN) was used for collecting fish larvae near the surface. The mouth diameter was 1.6 m and the mesh opening was 5.0 mm. A flow meter (GO-2030R: General Oceanics, Inc.) was mounted in the mouth of the frame to register the volume of water that passed through the net. The Larval net was deployed from starboard on the working deck.

An Electronic Plankton Counting and Sizing System (EPCS: Nippon Kaiyo Co., Ltd.) was used for the continuous monitoring of oceanographic conditions and collecting water samples during the cruises. Seawater was pumped up from the bottom of the ship (ca. 5 m). The sensors were for conductivity, temperature and pressure (SBE 4: Sea-Bird Electronics, Inc.), fluorescence (10-AU: Tuner Designs Inc.) and particle count and sizing by Laser Optical Particle Counter (LOPC: ODIM Brook Ocean, Inc.). Optionally, a Fast Repetition Rate Fluorescence system (FRRF: Kimoto Electric Co., Ltd.) was attached at the end of the flow line to measure physiological activity of the phytoplankton community.

Core, Dredge and Grab samplers were used for collecting bottom mud and benthic organisms. The Grab samplers were Ekman-Birge and Smith-McEntire types (Rigo Co., Ltd). The Core sampler has composed of 4 cylinders (Rigo Co., Ltd). Grab and core samplers were deployed from starboard on the working deck. We used a Niino-type Dredge sampler (Rigo Co., Ltd), which was obliquely towed from the afterdeck.

During some cruises fishery operations were conducted simultaneously, like Drum Seine Gera (DSG), Long-line Fishing (LF) and Bottom Trawl (BT); the details of the methodologies will be described in the other reports.

### Overview of cruises and observations

The T/V *Kagoshima-maru* conducted 23 cruises during the academic year 2014 (Table 1). The total number of cruise days and participants in this academic year were 152 days and 644 persons, respectively. The areas where the T/V *Kagoshima-maru* performed trainings covered the western North Pacific Ocean, East China Sea and their adjacent

Table 1. Cruise information on the T/V *Kagoshima-maru* during the academic year 2014.

Cruise ID	Period		Days	Cruise track	Users	Number of persons		
	Start	End				SC	ST	OP
KG14-01	Apr 09	Apr 10	2	Fig. 2	KUFF	3	36	
KG14-02	Apr 12	Apr 12	1	Fig. 3	KUFF	3	35	
KG14-03	Apr 15	Apr 17	3	Fig. 4	KUFF	2	10	2
KG14-04	Apr 19	Apr 20	2	Fig. 5	KUFF	3	37	
KG14-05	May 09	May 14	6	Fig. 6	KUFF FFKU	3	29 5	
KG14-06	May 23	May 29	7	Fig. 7	KUFF NUBS	3 1	18 15	1
KG14-07	Jun 01	Jun 01	1	Fig. 8	KUFF OUJ	2	8 19	1 2
KG14-08	Jun 03	Jun 04	2	Fig. 9	KUFF KUFLEH SLWU	1 2 1	8 10 11	
KG14-09	Jun 07	Jun 22	16	Fig. 10	KUFF CIMES	4 1	23 2	1
KG14-10	Jul 07	Jul 11	5		KUFF			
KG14-11	Jul 29	Jul 29	1		KUFF			
KG14-12	Aug 01	Aug 02	2		KUFF			
KG14-13	Aug 07	Aug 10	4		KUFF			
KG14-14	Aug 18	Sep 25	39	Fig. 11	KUFF SRUFFMS	1 3	15 44	
KG14-15	Oct 04	Oct 06	3		KUFF			
KG14-16	Oct 09	Oct 17	9	Fig. 12	KUFF	2	32	
KG14-17	Oct 24	Oct 29	6	Fig. 13	KUFF KUFA	2 1	12 22	5
KG14-18	Nov 04	Nov 11	8	Fig. 14	KUFF FAKU NUFSES UTSS	2 1 1 1	22 6 1	
KG14-19	Nov 14	Nov 18	5	Fig. 15	KUFF KUST	1	8 16	
KG14-20	Nov 26	Nov 30	5	Fig. 16	KUFF MUFA	2	8 31	
KG14-21	Dec 18	Dec 20	3	Fig. 17	KUFF KUSMB	1 3	40	
KG14-22	Feb 16	Feb 19	4	Fig. 18	KUFF		30	
KG14-23	Feb 22	Mar 11	18	Fig. 19	KUFF		30	

## Abbreviations

## Users

KUFF	Faculty of Fisheries, Kagoshima University
NUBS	College of Bioresources Science, Nihon University
KUFA	Faculty of Agriculture, Kinki University
CIMES	Center for Marine Environmental Studies, Ehime University
FAKU	Faculty of Agriculture, Kyushu University
MUFA	Faculty of Agriculture, Miyazaki University
UTSS	Graduate School of Science, the University of Tokyo
KUST	Graduate School of Science and Technology, Kumamoto University
OUJ	The Open University of Japan
FFKU	Faculty of Fisheries, Kasetsart University
KUSMB	School of Marine Biosecience, Kitasato University
SRUFFMS	Faculty of Fisheries and Marine Science, Sam Ratulangi Univeristy
NUFSES	Guraduate School of Fisheries Sciences and Environmental Studies, Nagasaki University
KUFLEH	Faculty of Law, Economics and Humanities, Kagoshima University
SLWU	School of Law, Waseda University

## Number of persons

SC	Scientist
ST	Student
OP	Other person

waters (Fig. 1). In 15 of these cruises, oceanographic observations were carried out using instruments onboard the T/V *Kagoshima-maru*.

Table 2 shows general information on the oceanographic observations conducted by the T/V *Kagoshima-maru* during the academic year 2014. During April 2014, three cruises were performed in the Kagoshima Bay as 'Freshman Seminars' for 1<sup>st</sup>-year students (KG14-01, KG14-02 and KG14-04), and one cruise was carried out in the Tokara Strait as an extra activity in order to measure the Kuroshio flow under the contract with Mitsubishi heavy industries, LTD. (KG14-03). Thirteen cruises have been conducted under the Joint-use System of Educational Facilities from May to November 2014, with teaching staff and under- and post-graduate students from the Faculty of Fisheries, Kagoshima University and other universities (KG14-05,

KG14-06, KG14-07, KG14-08, KG14-09, KG14-14, KG14-16, KG14-17, KG14-18, KG14-19, KG14-20, KG14-22, and KG14-23). One cruise has been done under the Joint-use System of Educational Facilities in December 2014, especially for on-board training of undergraduate students from the School of Marine Bioscience, Kitasato University (KG14-21). The major objectives of these cruises were devoted to trainings of navigation and seamanship, fishing gear operation, oceanographic observations and biological sample collections. CTD-CMS observations were carried out in 14 cruises, and such an observing system was most frequently used onboard among the cruises in the academic year 2014. The NORPAC net was second-most-frequently used onboard. The detailed information on the data and samples collected during these cruises is available by contacting the persons listed in Table 2.

Table 2. General information on oceanographic observations carried out by the T/V *Kagoshima-maru* in 23 cruises during the academic year 2014.

Cruise ID	Period		Days	Contact person	Major objectives	Shipboard instruments
	Start	End				
KG14-01	Apr 09	Apr 10	2	Dr. Y. Yamanaka	Freshman seminar	CTD-CMS, NORPAC, SMGS,
KG14-02	Apr 12	Apr 12	1	Dr. Y. Yamanaka	Freshman seminar	CTD-CMS, NORPAC, SMGS,
KG14-03	Apr 15	Apr 17	3	Dr. A. Nakamura	Hydrographic observation	ADCP, NB
KG14-04	Apr 19	Apr 20	2	Dr. Y. Yamanaka	Freshman seminar	CTD-CMS, NORPAC, SMGS,
KG14-05	May 09	May 14	6	Dr. K. Anraku	Fishing gear operation	CTD-CMS, SMGS, BT
KG14-06	May 23	May 29	7	Capt. M. Uchiyama	Fishing gear operation	CTD-CMS, BT
KG14-07	Jun 01	Jun 01	1	Dr. Y. Yamanaka	On-board training and seminar	CTD-CMS, NORPAC, SMGS,
KG14-08	Jun 03	Jun 04	2	Capt. M. Uchiyama	On-board seminar	
KG14-09	Jun 07	Jun 22	16	Dr. A. Nishina	Hydrographic observation	CTD-CMS, NB, ADCP, NORPAC, FRRF, EPCS
KG14-10	Jul 07	Jul 11	5	Capt. M. Uchiyama	Typhoon evacuation	
KG14-11	Jul 29	Jul 29	1	Capt. M. Uchiyama	Trail	
KG14-12	Aug 01	Aug 02	2	Capt. M. Uchiyama	Typhoon evacuation	
KG14-13	Aug 07	Aug 10	4	Capt. M. Uchiyama	Typhoon evacuation	
KG14-14	Aug 18	Sep 25	39	Capt. M. Uchiyama	Navigation and fishing gear operation	CTD-CMS, LF
KG14-15	Oct 04	Oct 06	3	Capt. M. Uchiyama	Typhoon evacuation	
KG14-16	Oct 09	Oct 17	9	Dr. S. Fuwa	Fishing gear operation and hydrographic observation	CTD-CMS, NORPAC, SMGS, BT
KG14-17	Oct 24	Oct 29	6	Dr. K. Anraku	Fishing gear operation	CTD-CMS, NORPAC, LN, DSG
KG14-18	Nov 04	Nov 11	8	Dr. T. Kobari	Hydrographic observation and biological sample collection	CTD-CMS, NORPAC, LN, MOCNESS, FRRF, ADCP, BT
KG14-19	Nov 14	Nov 18	5	Capt. M. Uchiyama	Hydrographic observation and biological sample collection	CTD-CMS, NORPAC, LN, DS
KG14-20	Nov 26	Nov 30	5	Capt. M. Uchiyama	Hydrographic observation and biological sample collection	CTD-CMS, NORPAC, LN, DS
KG14-21	Dec 18	Dec 20	3	Capt. M. Uchiyama	Hydrographic observation and biological sample collection	CTD-CMS, NORPAC, LN
KG14-22	Feb 16	Feb 19	4	Capt. M. Uchiyama	Fishing gear operation and hydrographic observation	
KG14-23	Feb 22	Mar 11	18	Capt. M. Uchiyama	Navigation and fishing gear operation	

Abbreviations	
CTD-CMS	Conductivity, Temperature and Depth Sensors with Carousel Multisampler
ADCP	Vessel-mounted Acoustic Doppler Current Profiler
NB	Niskin Bottle
EPCS	Electronic Plankton Counting and Sizing System
FRRF	Fast Repetition Rate Fluorometry
VMPS	Vertical Multiple-opening Plankton Sampler
MOCNESS	Multiple Opening Closing Net and Environmental Sensing System
NORPAC	North Pacific Standard Net
LN	Larval Net
SMGS	Smith-McEntire Grab Sampler
DS	Dredge Sampler
DSG	Drum Seine Gera
LF	Longline Fishing
BT	Bottom Trawl

### Lists of research presentations and publications

This section provides information on research presentations and published papers the observations carried out using the T/V *Kagoshima-maru* in the academic year 2014

#### Presentations

1) Kobari T., T. Kawabuchi and Makihara W. (2015). Regional

comparisons of zooplankton biomass and production rate in Kuroshio and its neighboring waters. Spring Meeting of the Oceanographic Society of Japan, Tokyo, Japan. (Poster presentation)

#### Publications

1) Fujieda, S., M. Higashi, A. Habano, T. Azuma, Y. Arita, F. Makino (2014). Ingestion of plastic debris by tuna caught in the North Pacific Ocean., *Jour. Jap. Drif. Soc.*, 12: 47–48.

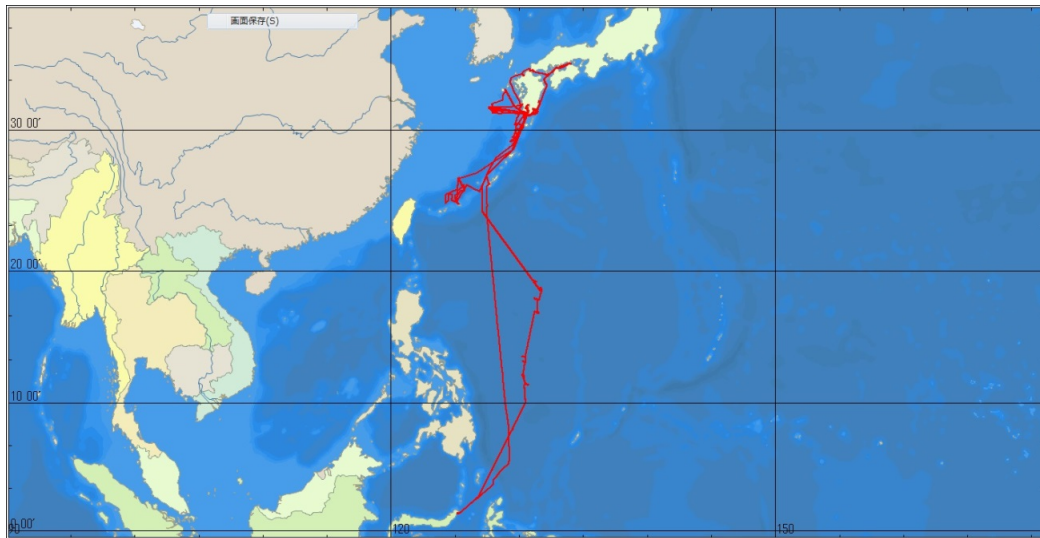


Fig. 1. Cruise tracks of the T/V *Kagoshima-maru* during 2014 academic year.

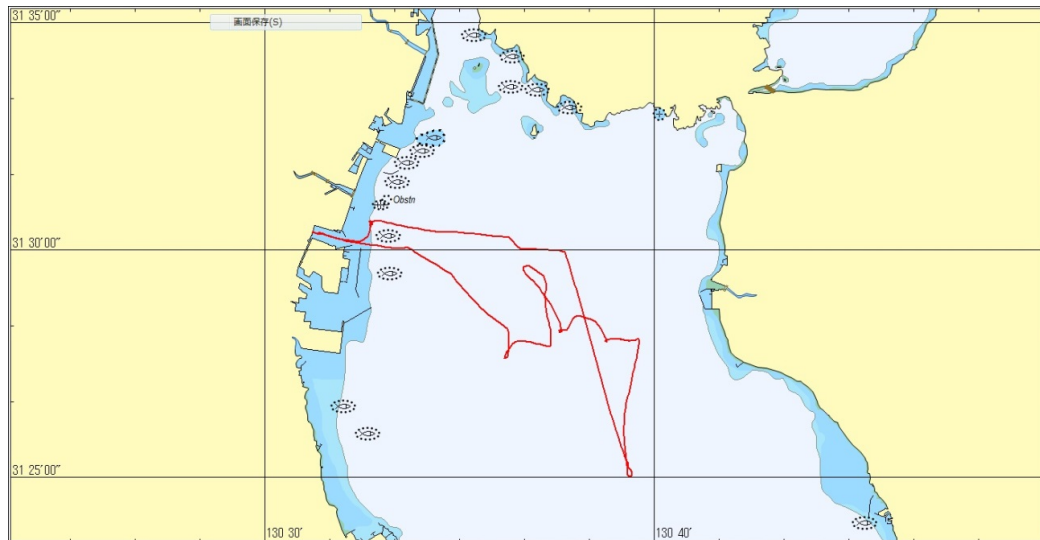


Fig. 2. Cruise tracks of the T/V *Kagoshima-maru* during KG14-01.

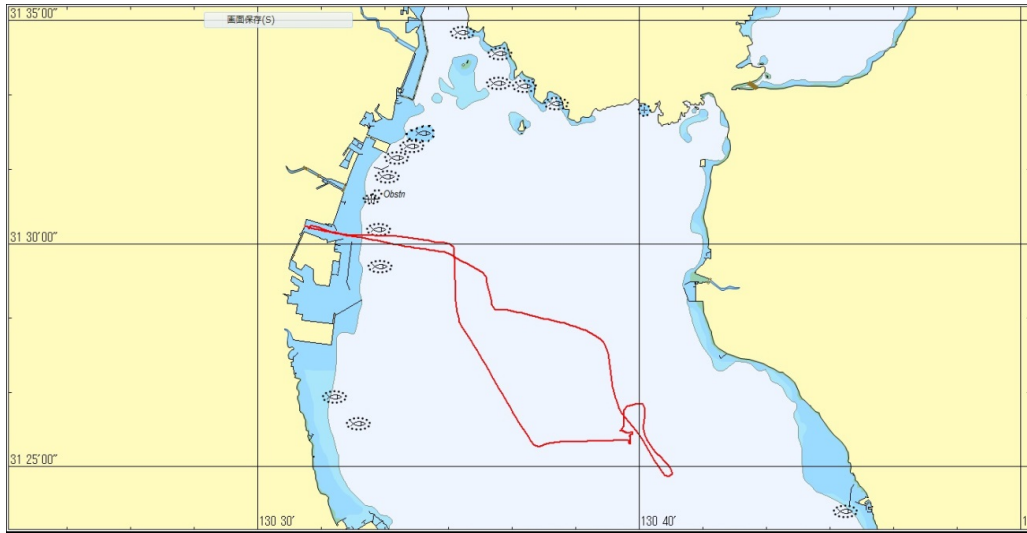


Fig. 3. Cruise tracks of the T/V *Kagoshima-maru* during KG14-02.



Fig. 4. Cruise tracks of the T/V *Kagoshima-maru* during KG14-03.

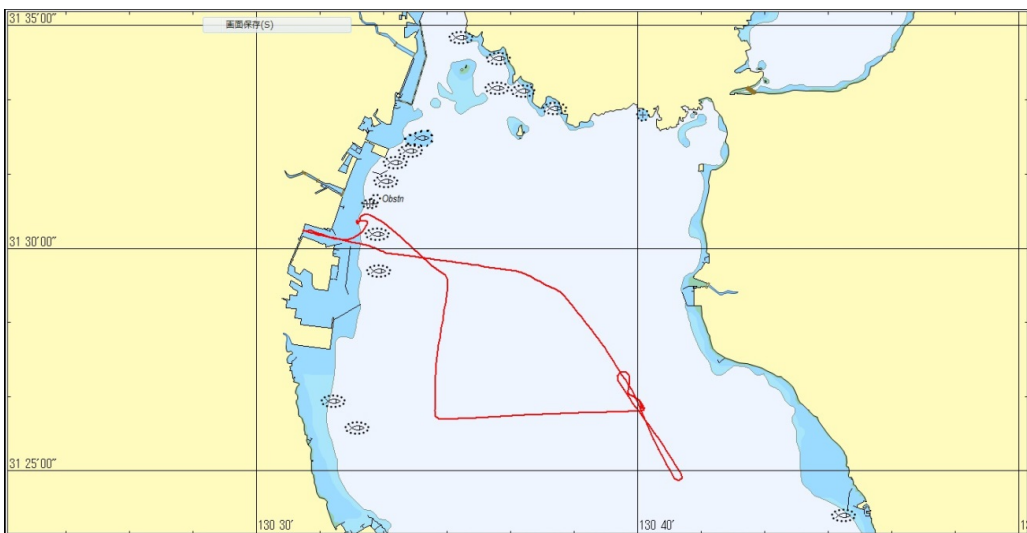


Fig. 5. Cruise tracks of the T/V *Kagoshima-maru* during KG14-04.

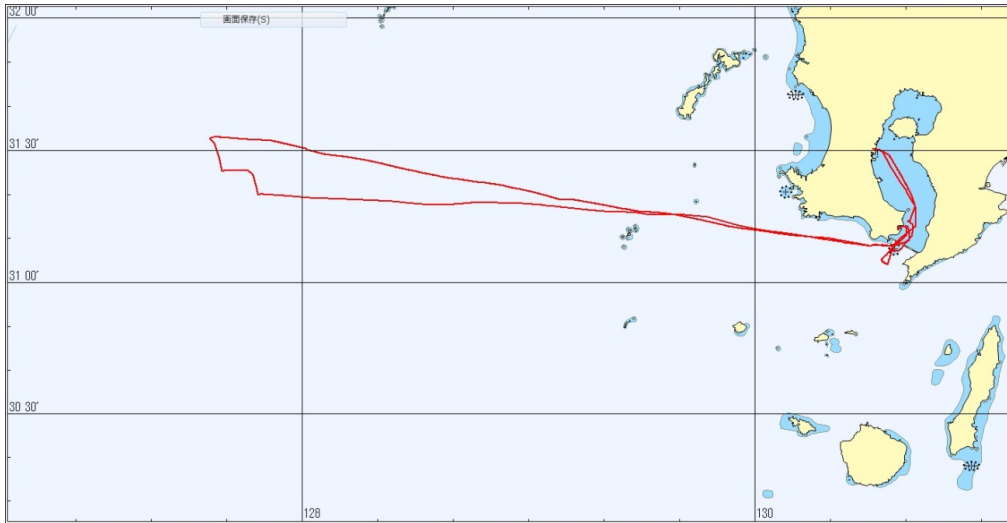


Fig. 6. Cruise tracks of the T/V *Kagoshima-maru* during KG14-05.

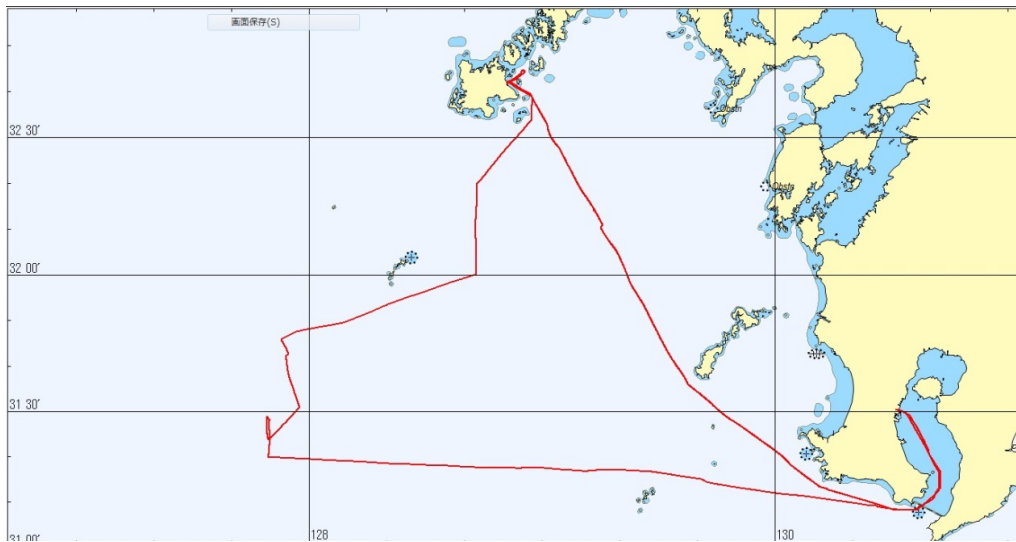


Fig. 7. Cruise tracks of the T/V *Kagoshima-maru* during KG14-06.



Fig. 8. Cruise tracks of the T/V *Kagoshima-maru* during KG14-07.



Fig. 9. Cruise tracks of the T/V *Kagoshima-maru* during KG14-08.

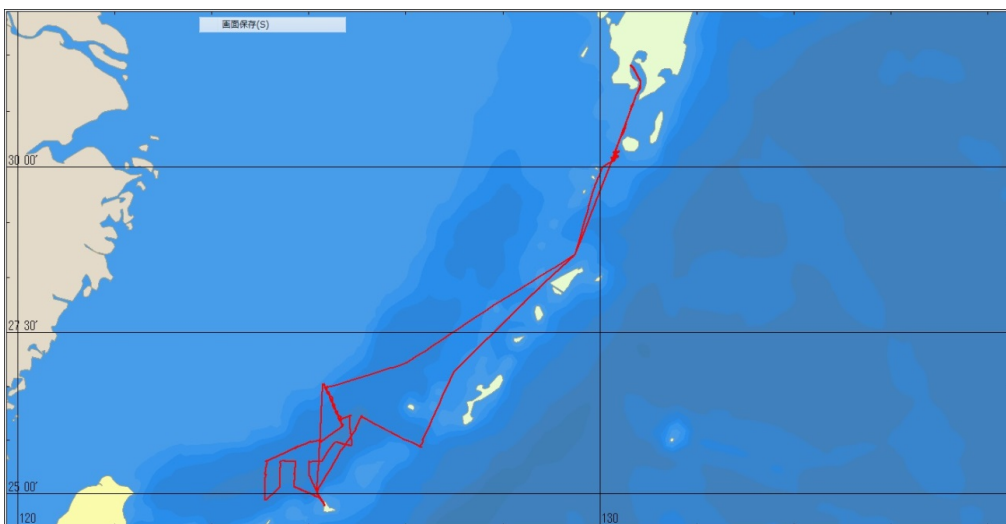


Fig. 10. Cruise tracks of the T/V *Kagoshima-maru* during KG14-09.

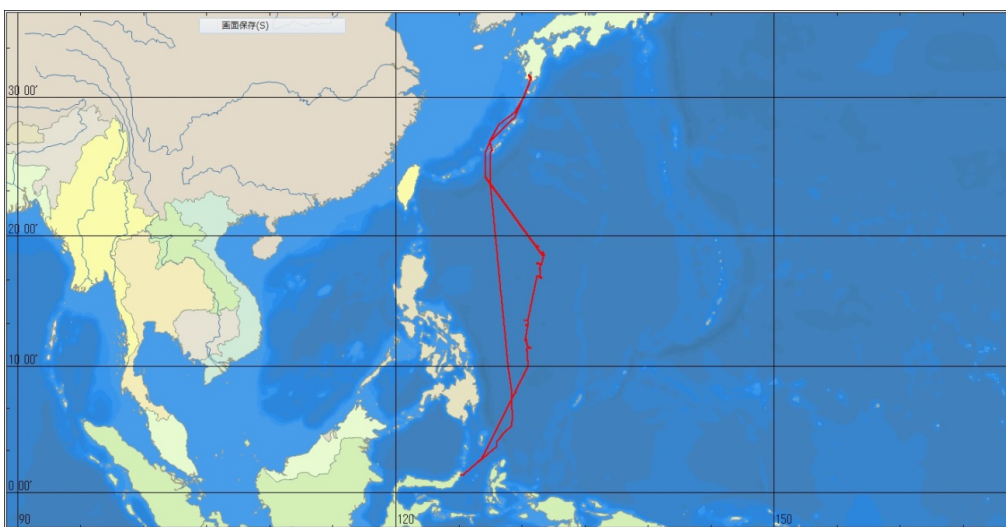


Fig. 11. Cruise tracks of the T/V *Kagoshima-maru* during KG14-14.



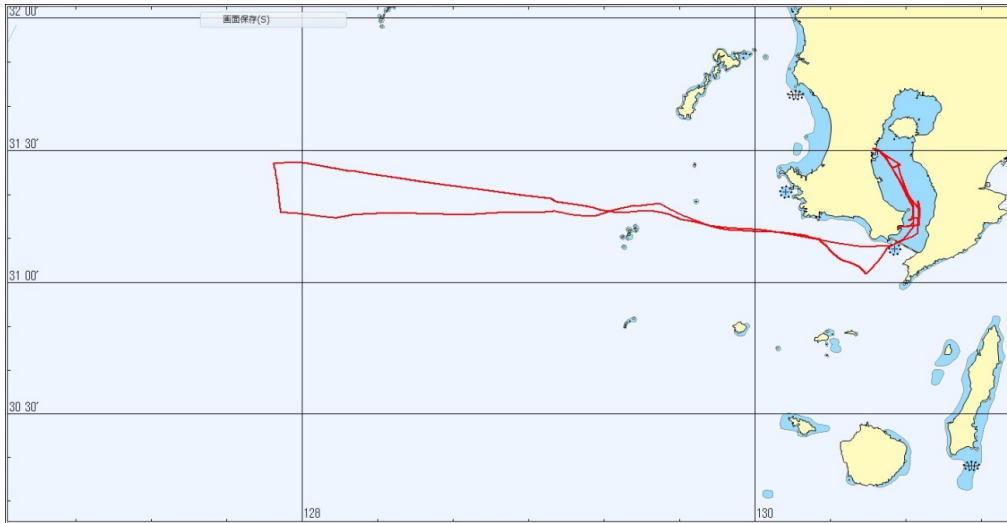


Fig. 12. Cruise tracks of the T/V Kagoshima-maru during KG14-16.



Fig. 13. Cruise tracks of the T/V Kagoshima-maru during KG14-17.

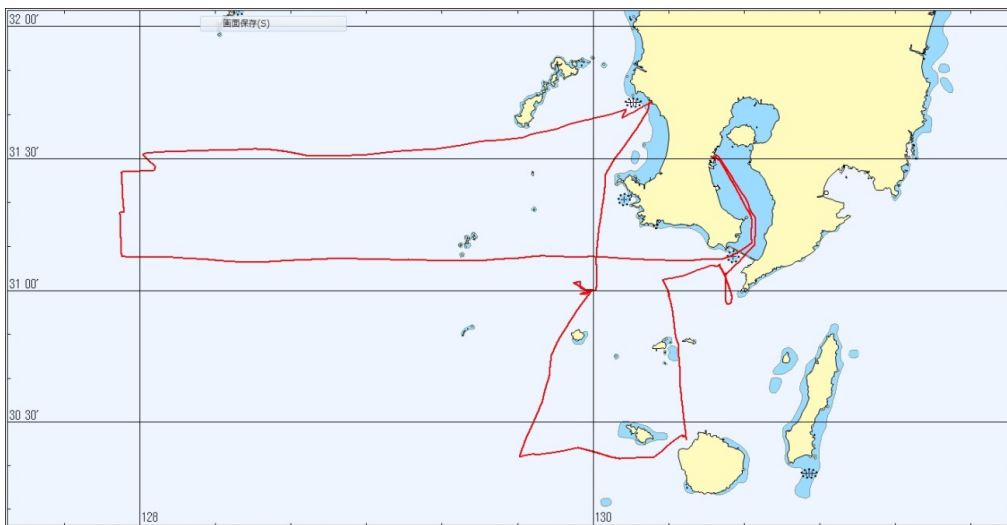


Fig. 14. Cruise tracks of the T/V Kagoshima-maru during KG14-18.

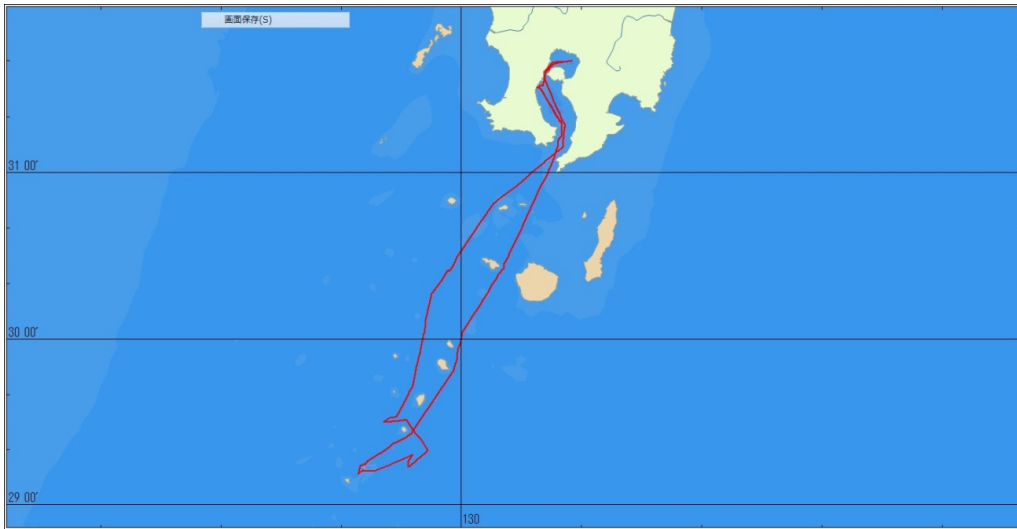


Fig. 15. Cruise tracks of the T/V Kagoshima-maru during KG14-19.

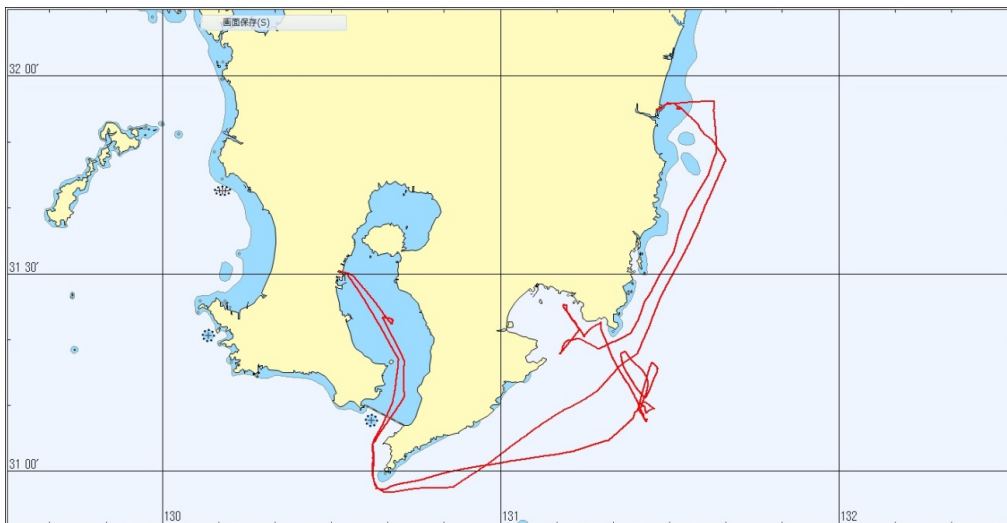


Fig. 16. Cruise tracks of the T/V Kagoshima-maru during KG14-20.



Fig. 17. Cruise tracks of the T/V Kagoshima-maru during KG14-21.

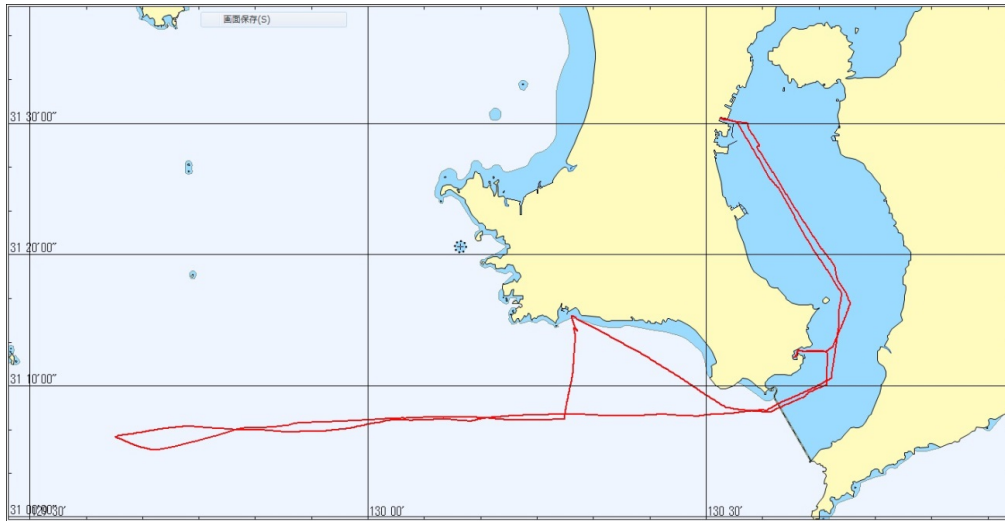


Fig. 18. Cruise tracks of the T/V *Kagoshima-maru* during KG14-22.

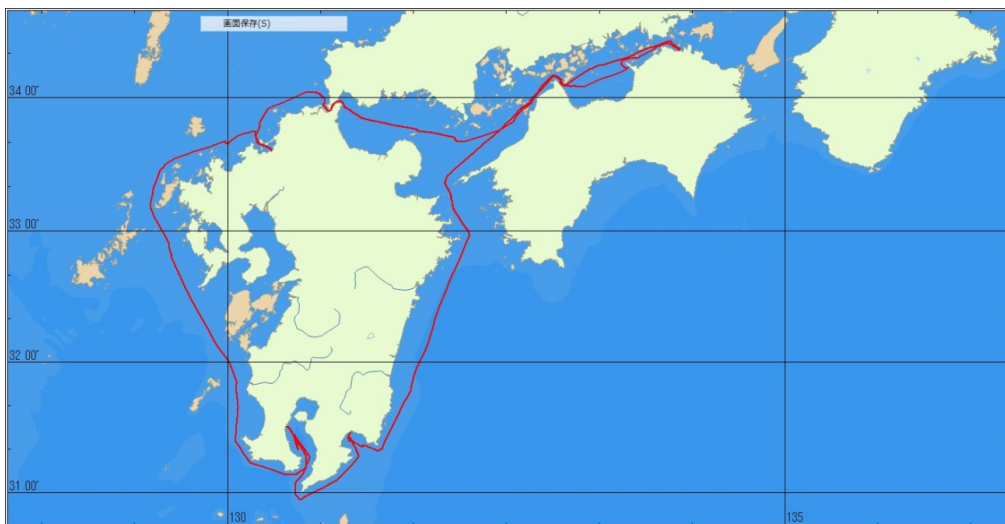


Fig. 19. Cruise tracks of the T/V *Kagoshima-maru* during KG14-23.