

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

Takafumi Azuma^{1*}, Akimasa Habano¹, Fumihiko Makino¹, Yoichi Arita¹, Atsushi Takeda¹,
Kanao Nasu¹, Masataka Higashi¹, Midori Matsuoka², Takahisa Mitsuhashi³ and Toru Kobari⁴

Key words: oceanographic observation, CTD, VMPS, MOCNESS

Abstract

In order to facilitate effective use of *T/V Kagoshima-maru*, we report an annual activity report of oceanographic observations by this vessel during April 2012 to March 2013. 19 cruises were conducted by *T/V Kagoshima-maru*. Total number of the cruise days and participants was 152 days and 565 persons, respectively. *T/V Kagoshima-maru* covered the central to western North Pacific Ocean, East China Sea and its neighboring areas.

Introduction

Kagoshima-maru is a training vessel (T/V) of Faculty of Fisheries, Kagoshima University, which was constructed in March 2012. Since *T/V Kagoshima-maru* was officially approved for a shared-use training vessel by Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), various shared-use programs have been conducted between Faculty of Fisheries, Kagoshima University and the other educational and scientific institutions. Here, we report an annual summary of oceanographic observations carried out during April 2012 to March 2013 by *T/V Kagoshima-maru* in order to promote such shared-use programs

Specifications and operations of shipboard instruments

This section provides general information on specifications and operating procedures of shipboard instruments for oceanographic observations and sample collections. Details of

the information will be found at the publications listed below.

Conductivity-Temperature-Depth Profiler System with a 24-position Carousel Multiple Sampler (CTD-CMS), was conducted 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, Expendable Bathythermograph (XBT T-5 or T-7: Tsurumi-Seiki-Kosakusho Co., Ltd) was used for recording vertical profile of water temperature during sailing. 12-liter X-Niskin Bottles attached with CMS were used for collecting seawater. Occasionally, seawater sample was collected by normal Niskin or GO-FLO bottles attached on the wire at the desired depths. These bottles were closed by messengers. CTD-CMS, Niskin and GO-FLO were deployed from starboard on working deck.

¹ Kagoshima-maru, Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

² Technical Service Department, Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

³ Shared-use program of Training vessel, Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

⁴ Fisheries Biology and Oceanography, Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

*corresponding author (T. Azuma)

Address: Kagoshima Maru, Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

Email: azuma@fish.kagoshima-u.ac.jp

Phone: +81-99-286-4111

Fax: +81-99-286-4015

For monitoring bathymetry and underwater substrates, *T/V Kagoshima-maru* has two different sonar instruments, Acoustic Doppler Current Profiler (Ocean Surveyor ADCP: Teledyne-RD Instruments, Inc.) and Scientific Echo Sounder (EK60: Simrad,). Available working frequencies were 75 kHz for Acoustic Doppler Current Profiler (ADCP) and 12, 38, 120 and 200 kHz for 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.

Vertical Multiple-opening Plankton Sampler (VMPS: Tsurumi-Seiki-Kosakusho Co., Ltd), was conducted for hydrographic observations using the sensors for conductivity, temperature and pressure (SBE 52MP: Sea-Bird Electronics Inc.) and fluorescence (ECOFLNTU(RT)D: WET Labs, Inc.) and collecting depth-stratified zooplankton samples. The mouth opening was 0.25 m². 4 multiple nets were attached and two different mesh openings (0.1 mm and 0.064 mm) were available. A flowmeter (Rigo Co., Ltd) was mounted in the mouth of the frame to register the volume of water that passed through the net. VMPS was deployed from starboard on working deck.

Multiple Opening Closing Net and Environmental Sensing System (MOCNESS: Biological Environmental Sampling System, Inc.), was done for collecting depth-stratified zooplankton samples during the cruises. The mouth opening was 4 m². 6 multiple nets were attached and two different mesh openings (0.335 mm and 0.125 inch) were available. The sensors were for conductivity, temperature and pressure (Sea-Bird Electronics, Inc.), altimeter (Teledyne Benthos, Inc.), and fluorescence (WET Labs, Inc.). A flowmeter (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 rear on working deck.

North Pacific Standard (NORPAC) net was done for collecting zooplankton samples during the cruises. The mouth diameter was 0.45 m. The two different mesh openings (0.1 mm and 0.335 mm) were available. A flowmeter (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 working deck.

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

from starboard on working deck.

Electronic Plankton Counting and Sizing System (EPCS:Nippon Kaiyo Co., Ltd.), was conducted for continuous monitoring oceanographic conditions and collecting water sample during the cruises. Seawater was pumped up from the bottom of the vessel (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, Fast Repetition Rate Fluorescence (FRRF: Kimoto Electric Co., Ltd.) was attached at the end of the flow line to measure physiological activity of phytoplankton community.

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

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

Overview of cruises and observations

T/V Kagoshima-maru conducted 18 cruises during April to December 2012 and 1 cruise from February to March 2013 (Table 1). Total number of the cruise days and participants was 152 days and 565 persons, respectively. *Kagoshima-maru* covered the central to western North Pacific Ocean, East China Sea and their neighboring areas (Fig. 1).

General information on oceanographic observations was shown in Table 2. Freshman seminar for undergraduate students has been regularly done during the cruises in April (KG12-01, KG12-03 and KG12-04). On-board training for undergraduate students in Faculty of Fisheries, Kagoshima University, was done during 10 cruises (KG12-05, KG12-07, KG12-08, KG12-09, KG12-10, KG12-13, KG12-15, KG12-16, KG12-17, KG12-19). Major objectives of these cruises were fishing gear operation, hydrographic observations and biological sample collections. CTD-CMS was conducted during 11 cruises and the most frequent operations among the cruises carried by *T/V Kagoshima-maru*. NORPAC net was the next frequent operations. The detail information on data

Table 1. Cruise information on *T/V Kagoshima-maru* during April 2012 to March 2013.

Cruise ID	Period			Cruise track	Users	Number of persons		
	Start	End	Days			SC	ST	OP
KG12-01	Apr 13	Apr 15	3	Fig. 2	KUFF	3	35	
KG12-02	Apr 16		1	Fig. 3	KUFF		8	10
KG12-03	Apr 20	Apr 22	3	Fig. 4	KUFF	4	36	1
KG12-04	Apr 27	Apr 29	3	Fig. 5	KUFF	3	35	
KG12-05	May 11	May 14	4	Fig. 6	KUFF	3	11	19
KG12-06	May 15	May 15	1	Fig. 7	KUFF			
KG12-07	May 24	May 30	7	Fig. 8	KUFF	3	20	1
KG12-08	Jun 09	Jun 24	16	Fig. 9	NUBS	1	13	
					KUFF	2	19	4
					CIMES	2	4	
					HUNHS	2	3	
KG12-09	Jun 28	Jul 02	5	Fig. 10	UTSS	1	3	
					KUFF	4	25	12
KG12-10	Jul 04	Jul 08	5	Fig. 11	KUFF	2	8	17
KG12-11	Jul 21	Jul 21	1	Fig. 12	KUFF			
KG12-12	Jul 31	Aug 02	3	Fig. 13	KUFF			
KG12-13	Aug 10	Sep 25	47	Fig. 14	KUFF	1	23	
KG12-14	Sep 29	Sep 30	2	Fig. 15	KUFF		23	
KG12-15	Oct 12	Oct 16	5	Fig. 16	KUFF	3	14	4
					KUFA	1	16	
					KUST	1	1	
KG12-16	Oct 22	Oct 29	8	Fig. 17	KUFF	3	38	
KG12-17	Nov 01	Nov 08	8	Fig. 18	KUFF	2	25	2
					FAKU	1	11	
KG12-18	Nov 21	Nov 25	5	Fig. 19	KUFF	1	9	
					MUFA	2	32	
KG12-19	Feb 15	Mar 11	25	Fig. 20	KUFF	2	35	1

Abbreviations

Users

KUFF	Faculty of Fisheries, Kagoshima University
NUBS	College of Bioresources Science, Nihon University
CIMES	Center for Marine Environmental Studies, Ehime University
KUFA	Faculty of Agriculture, Kinki University
FAKU	Faculty of Agriculture, Kyushu University
MUFA	Faculty of Agriculture, Miyazaki University
HUNHS	Graduate School of Natural History Science, Hokkaido University
UTSS	Graduate School of Science, the University of Tokyo
KUST	Graduate School of Science and Technology, Kumamoto University

Number of persons

SC	Scientist
ST	Student
OP	Other person

Table 2. General information on oceanographic observations by *T/V Kagoshima Maru* in 19 cruises during April 2012 to March 2013.

Cruise ID	Period		Contact person	Major objectives	Shipboard instruments
	Start	End			
KG12-01	Apr 13	Apr 15	Dr. Y. Yamanaka	Freshman seminar	CTD-CMS, NORPAC, SMGS,
KG12-02	Apr 16		Capt. M. Higashi	Trail	
KG12-03	Apr 20	Apr 22	Dr. Y. Yamanaka	Freshman seminar	CTD-CMS, NORPAC, SMGS,
KG12-04	Apr 27	Apr 29	Dr. Y. Yamanaka	Freshman seminar	CTD-CMS, NORPAC, SMGS,
KG12-05	May 11	May 14	Dr. S. Fuwa	Fishing gear operation	DSG
KG12-06	May 15	May 15	Capt. M. Higashi	Trail	
KG12-07	May 24	May 30	Dr. I. Kimura	Fishing gear operation	CTD-CMS, BT
KG12-08	Jun 09	Jun 24	Dr. A. Nishina	Hydrographic observation	CTD-CMS, NB, XBT, ADCP, FRRF, EPCS, SES
KG12-09	Jun 28	Jul 02	Dr. S. Fuwa	Fishing gear operation	MT
KG12-10	Jul 04	Jul 08	Dr. S. Fuwa	Fishing gear operation	DSG
KG12-11	Jul 21	Jul 21	Capt. M. Higashi	Trail	
KG12-12	Jul 31	Aug 02	Capt. M. Higashi	Typhoon evacuation	
KG12-13	Aug 10	Sep 25	Capt. M. Higashi	Navigation and fishing gear operation	CTD-CMS, LF
KG12-14	Sep 29	Sep 30	Capt. M. Higashi	Typhoon evacuation	
KG12-15	Oct 12	Oct 16	Dr. K. Anraku	Fishing gear operation	CTD-CMS, SMGS
KG12-16	Oct 22	Oct 29	Dr. S. Fuwa	Fishing gear operation and hydrographic observation	CTD-CMS, NORPAC, SMGS, LN
KG12-17	Nov 01	Nov 08	Dr. T. Kobari	Hydrographic observation and biological sample collection	CTD-CMS, ADCP, NB, EPCS, VMPS, MOCNESS, NORPAC, LN, BT
KG12-18	Nov 21	Nov 25	Dr. T. Mitsuhashi	Hydrographic observation and biological sample collection	CTD-CMS, MOCNESS, NORPAC, SMGS, LN, BT
KG12-19	Feb 15	Mar 11	Capt. M. Higashi	Navigation and fishing gear operation	CTD-CMS, SES, BT

Abbreviations

CTD-CMS	Conductivity, Temperature and Depth Sensors with Carousel Multisampler
XBT	Expendable Baththermograph
ADCP	Vessel-mounted Acoustic Doppler Current Profiler
NB	Niskin Bottle
GOFLO	GO-FLO 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	Larva Net
SMGS	Smith-McEntire Grab Sampler
CS	Core Sampler
DS	Dredge Sampler
SES	Scientific Echo Sounder
DSG	Drum Seine Gera
LF	Longline Fishing
BT	Bottom Trawl
MT	Mid Water Trawl

and samples during these cruises would be available from the contact persons listed at Table 2.

Lists of research presentations and publications

This section provides information on research presentations and published papers relating to observations carried out using *T/V Kagoshima-maru* in the period from April 2012 to March 2013.

Presentations

1) Liu, Z., H. Nakamura, A. Nishina, J.-H. Park and M.

Wimbush (2012). The influence of topographic control on deep overflow of the Kerama Gap. American Geophysical Union 2012 Fall Meeting, San Francisco, USA.

Publications

1) Nakamura, H., A. Nishina, K. Tabata, M. Higashi, A. Habano and T. Yamashiro (2012). Surface velocity time series derived from satellite altimetry data in a section across the Kuroshio southwest of Kyushu. *J. Oceanogr.*, 68:321–336.

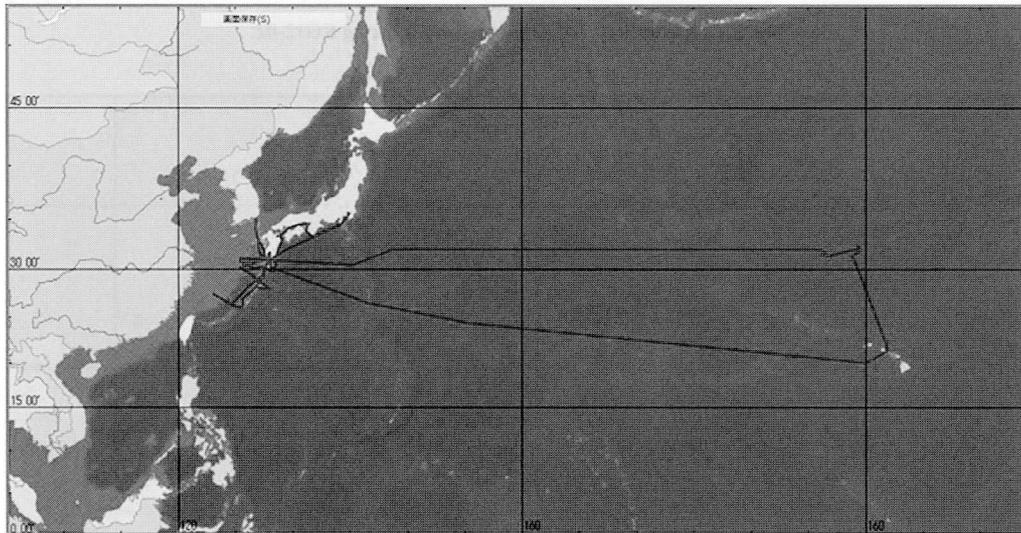


Fig. 1. Cruise tracks of *T/V Kagoshima-maru* during April 2012 to March 2013.

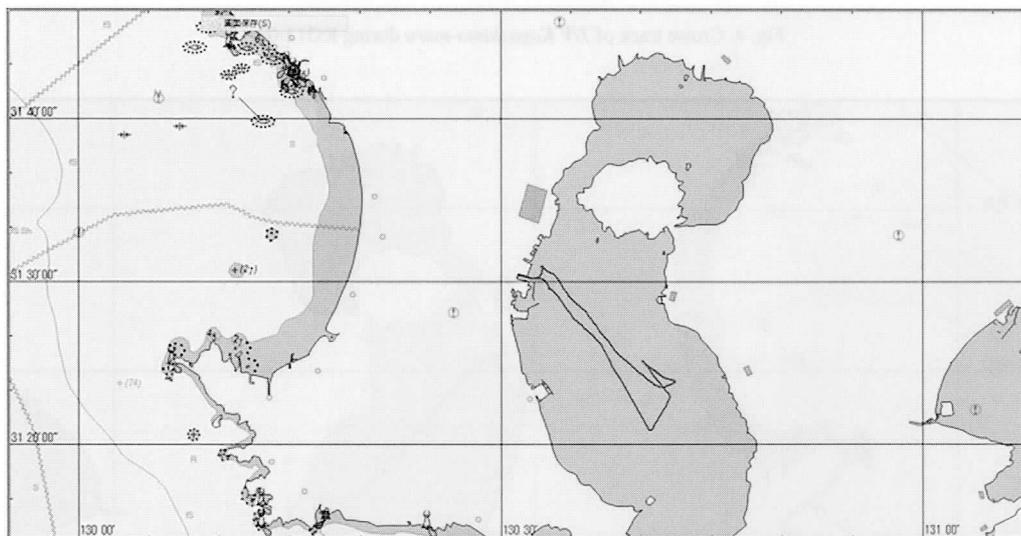


Fig. 2. Cruise track of *T/V Kagoshima-maru* during KG12-01.

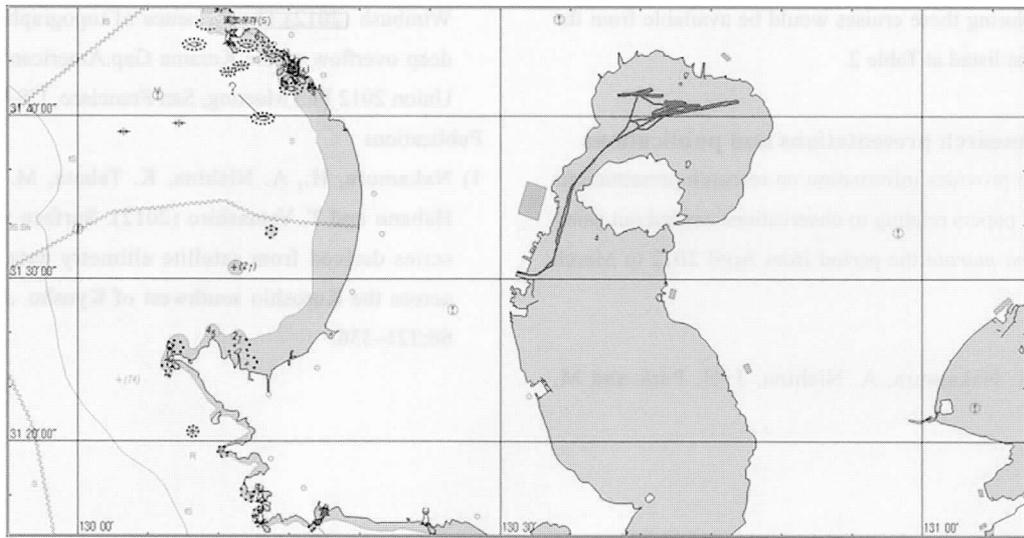


Fig. 3. Cruise track of *T/V Kagoshima-maru* during KG12-02.

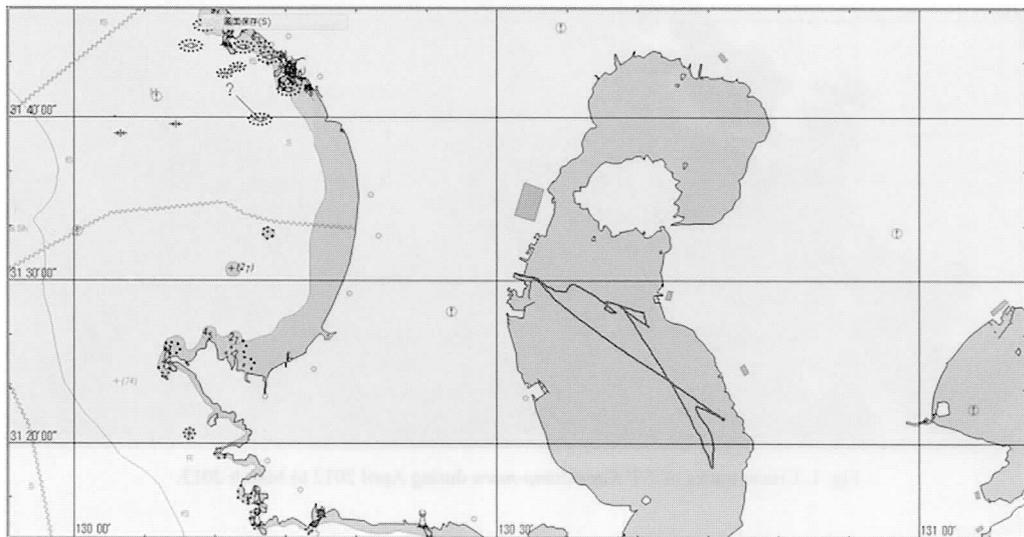


Fig. 4. Cruise track of *T/V Kagoshima-maru* during KG12-03.

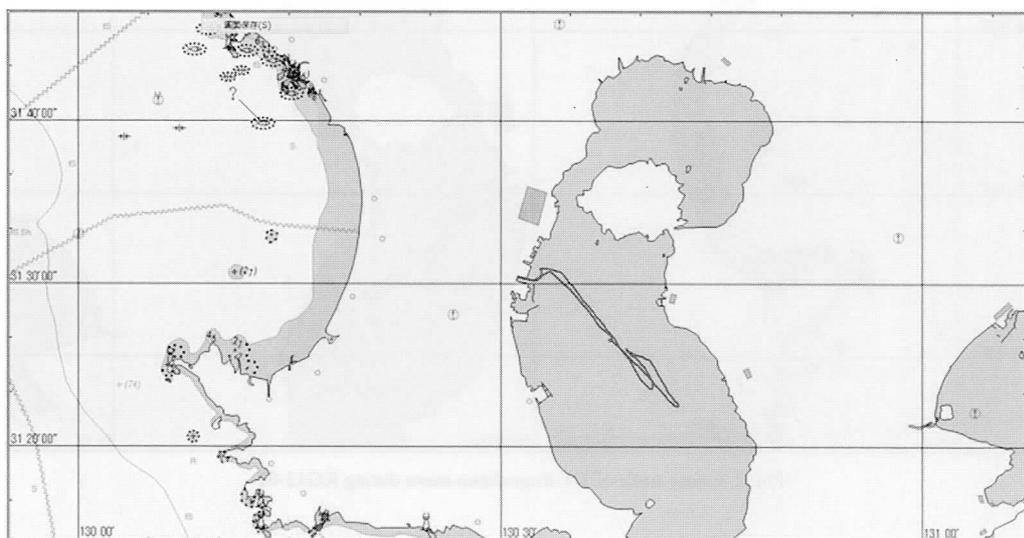


Fig. 5. Cruise track of *T/V Kagoshima-maru* during KG12-04.

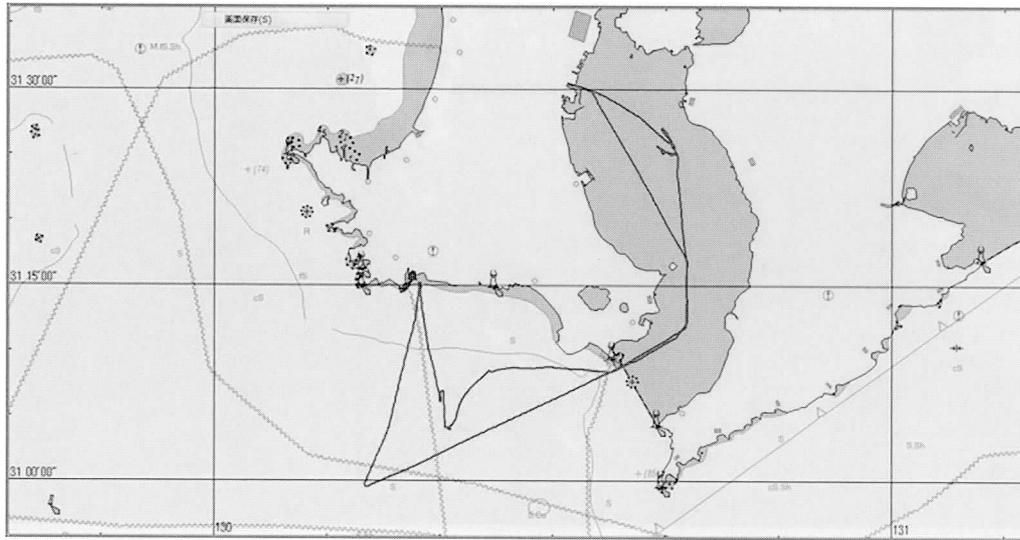


Fig. 6. Cruise track of *T/V Kagoshima-maru* during KG12-05.

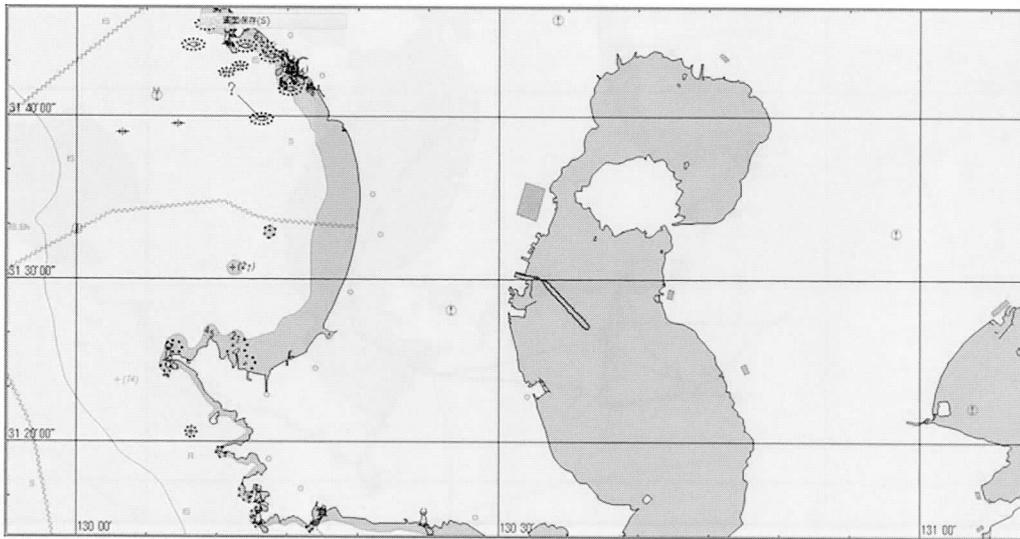


Fig. 7. Cruise track of *T/V Kagoshima-maru* during KG12-06.

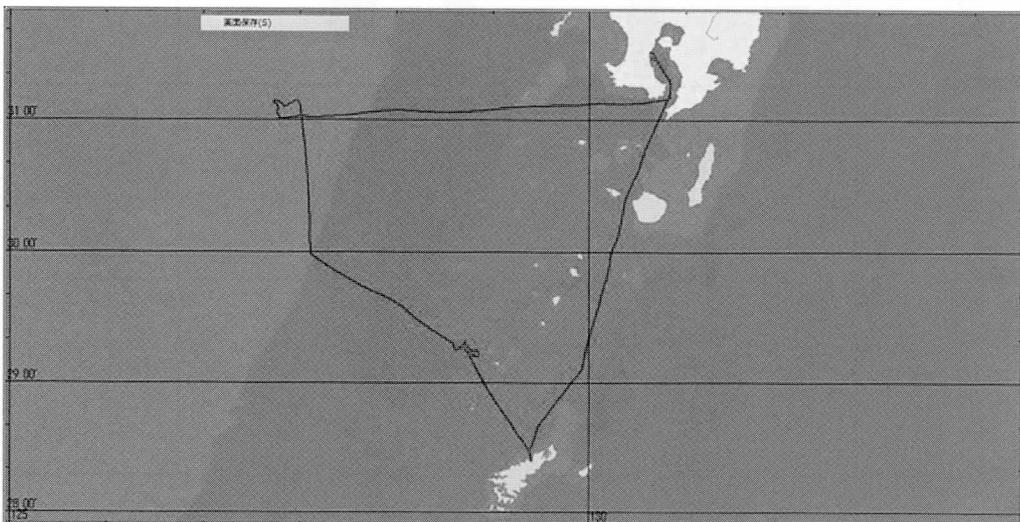
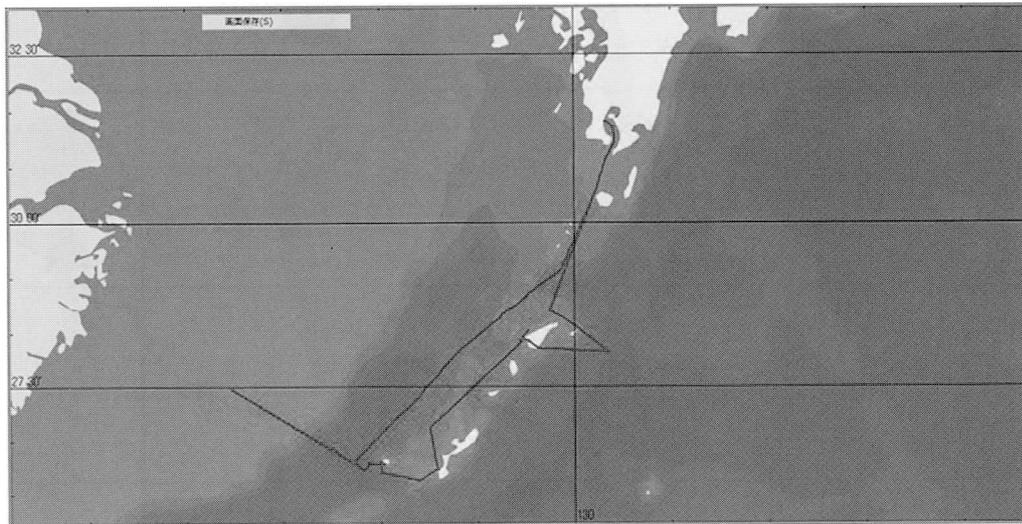
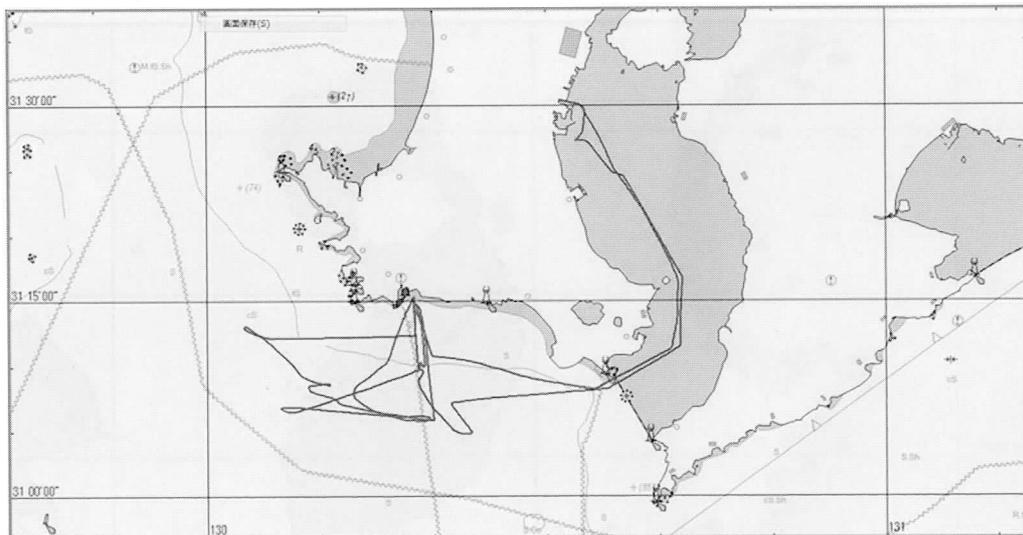
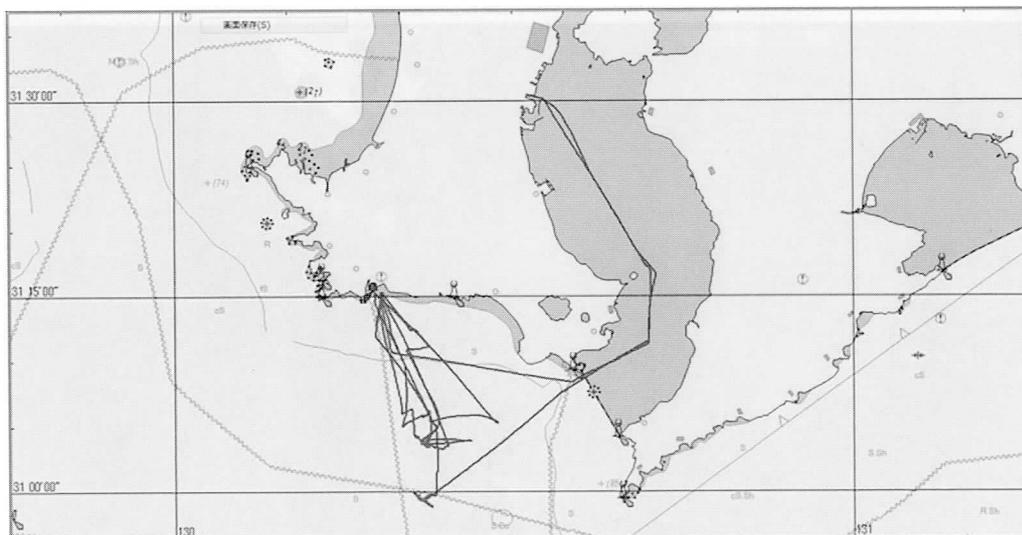


Fig. 8. Cruise track of *T/V Kagoshima-maru* during KG12-07.

Fig. 9. Cruise track of *T/V Kagoshima-maru* during KG12-08.Fig. 10. Cruise track of *T/V Kagoshima-maru* during KG12-09.Fig. 11. Cruise track of *T/V Kagoshima-maru* during KG12-10.

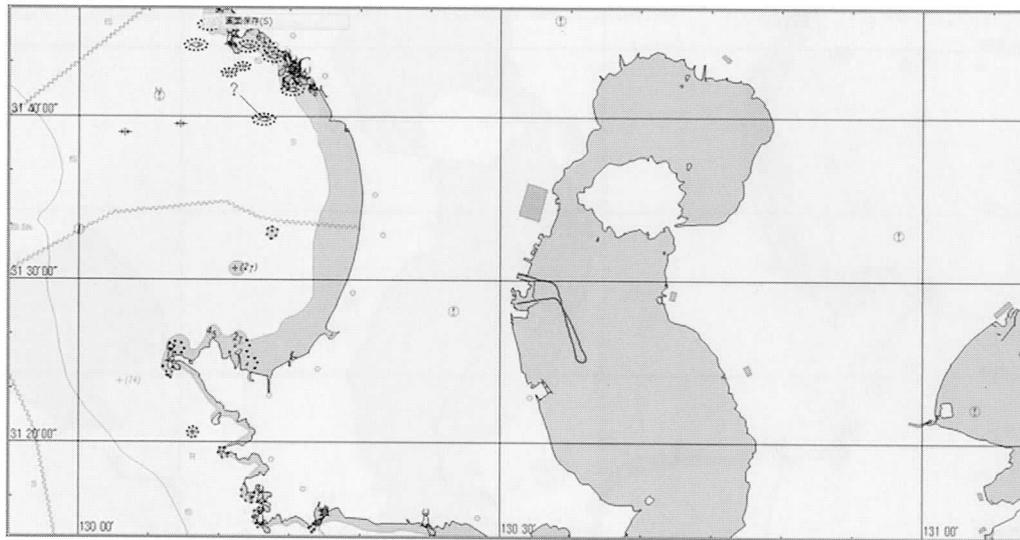


Fig. 12. Cruise track of *T/V Kagoshima-maru* during KG12-11.

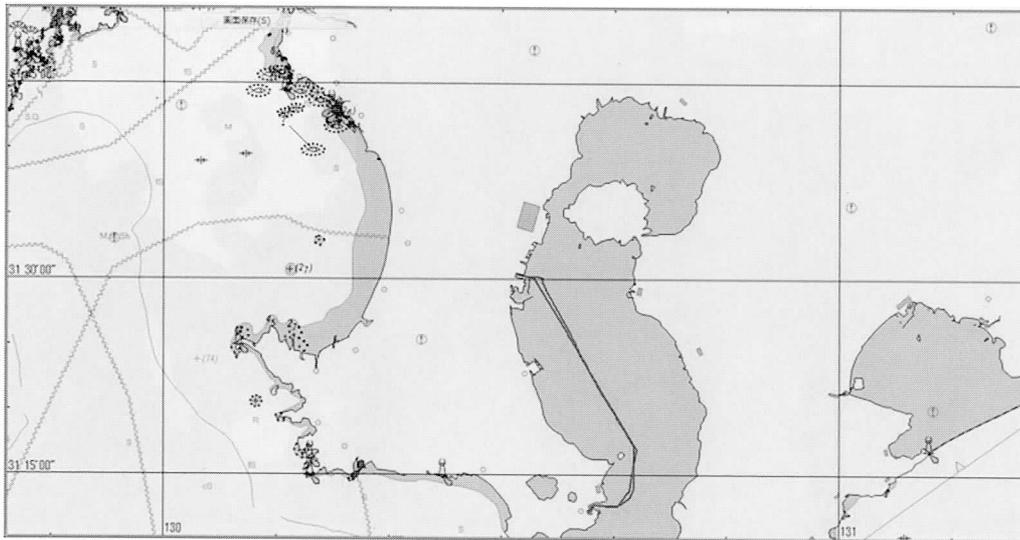


Fig. 13. Cruise track of *T/V Kagoshima-maru* during KG12-12.

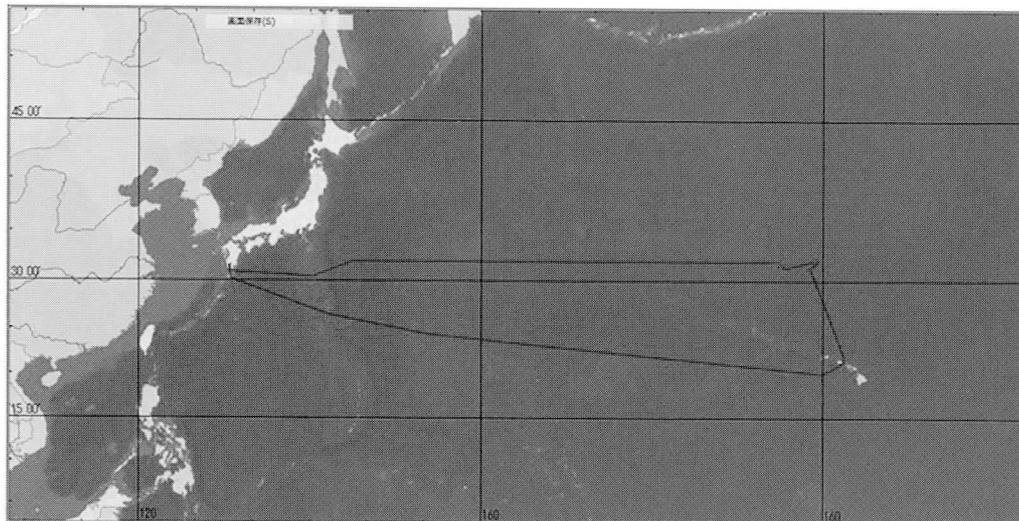


Fig. 14. Cruise track of *T/V Kagoshima-maru* during KG12-13.

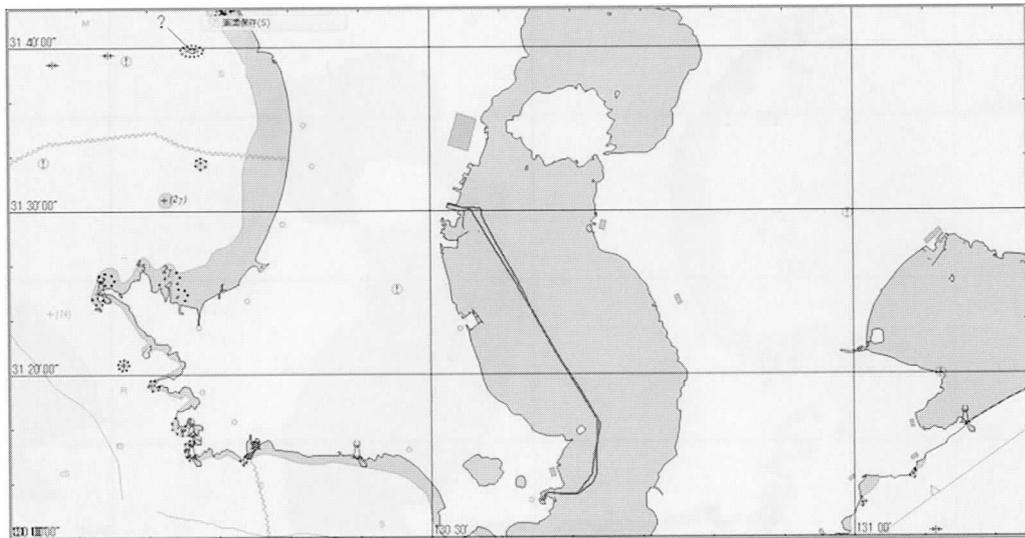


Fig. 15. Cruise track of T/V *Kagoshima-maru* during KG12-14.

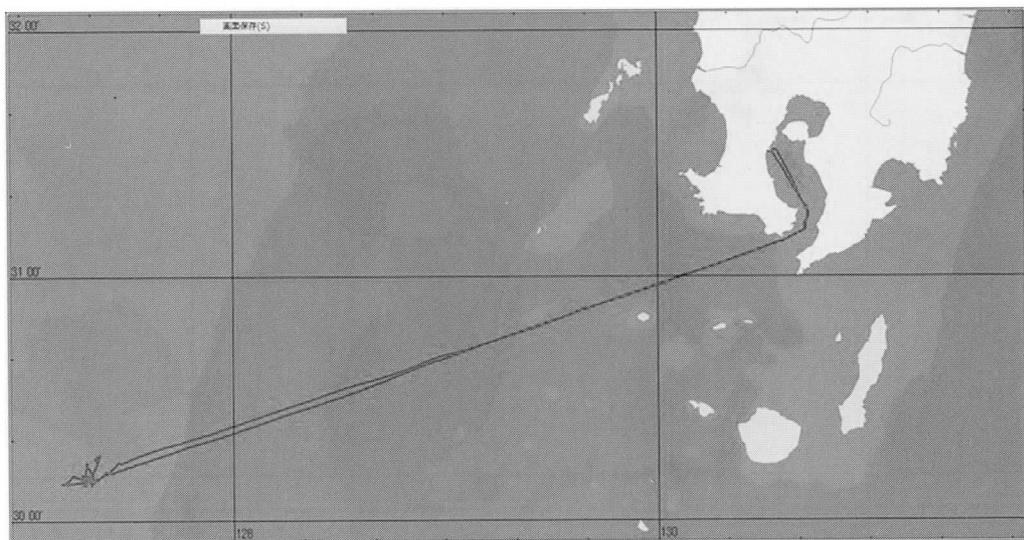


Fig. 16. Cruise track of T/V *Kagoshima-maru* during KG12-15.

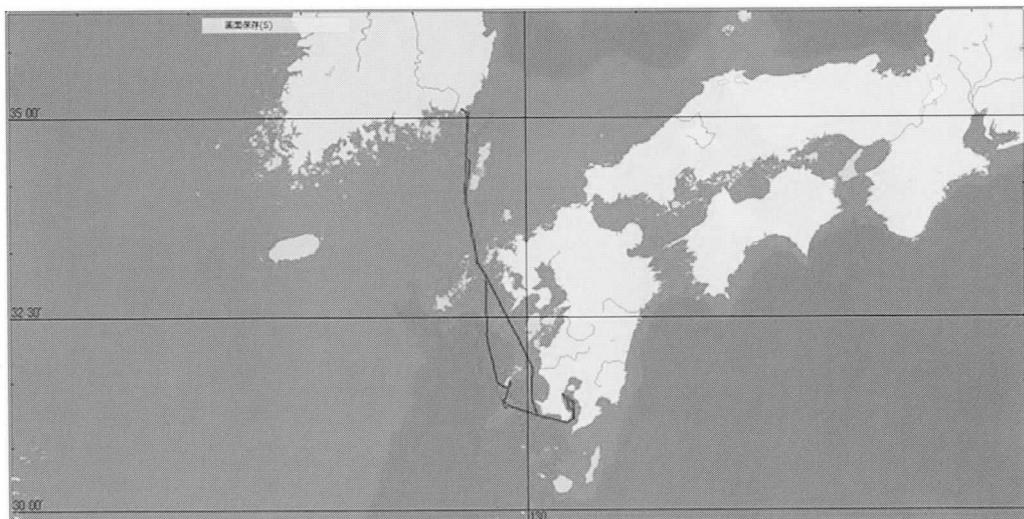


Fig. 17. Cruise track of T/V *Kagoshima-maru* during KG12-16.

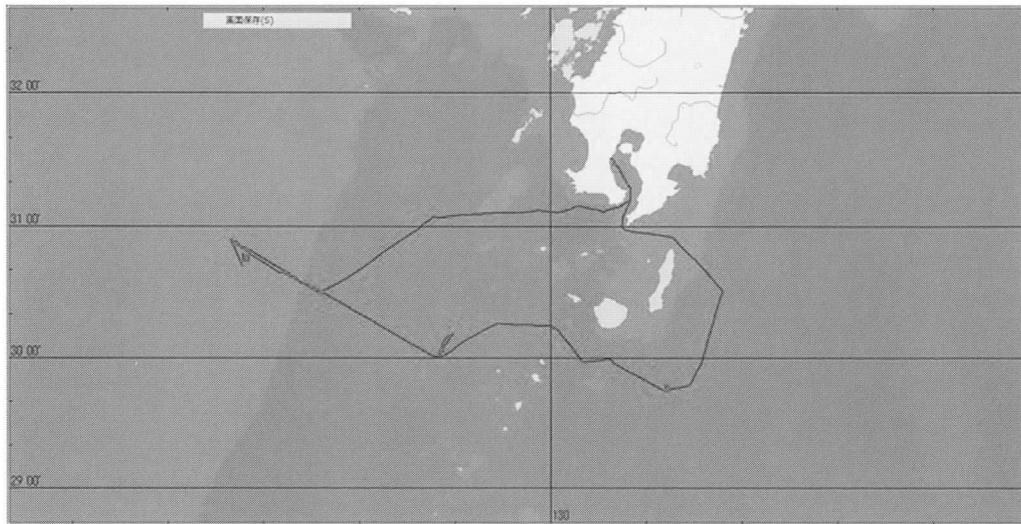


Fig. 18. Cruise track of T/V Kagoshima-maru during KG12-17.

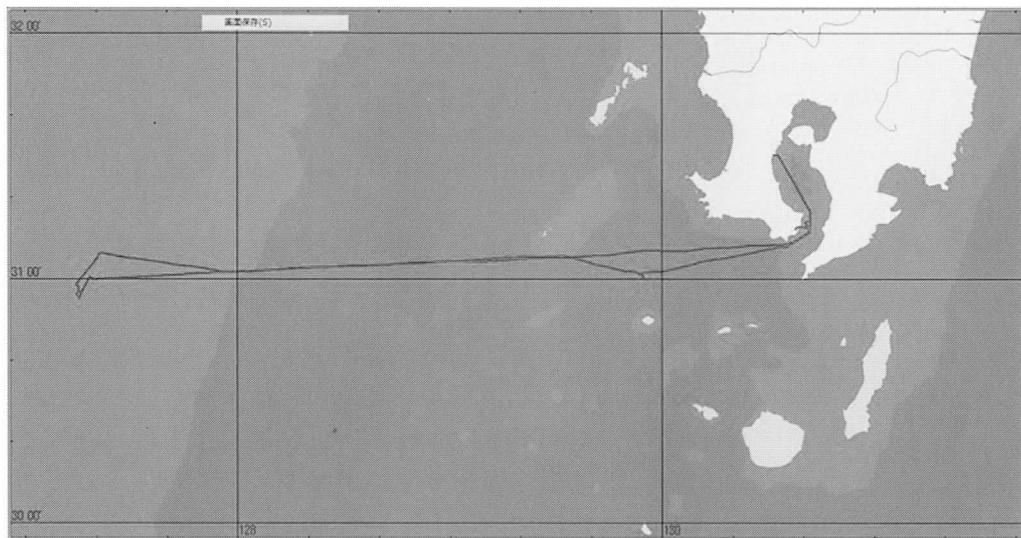


Fig. 19. Cruise track of T/V Kagoshima-maru during KG12-18.

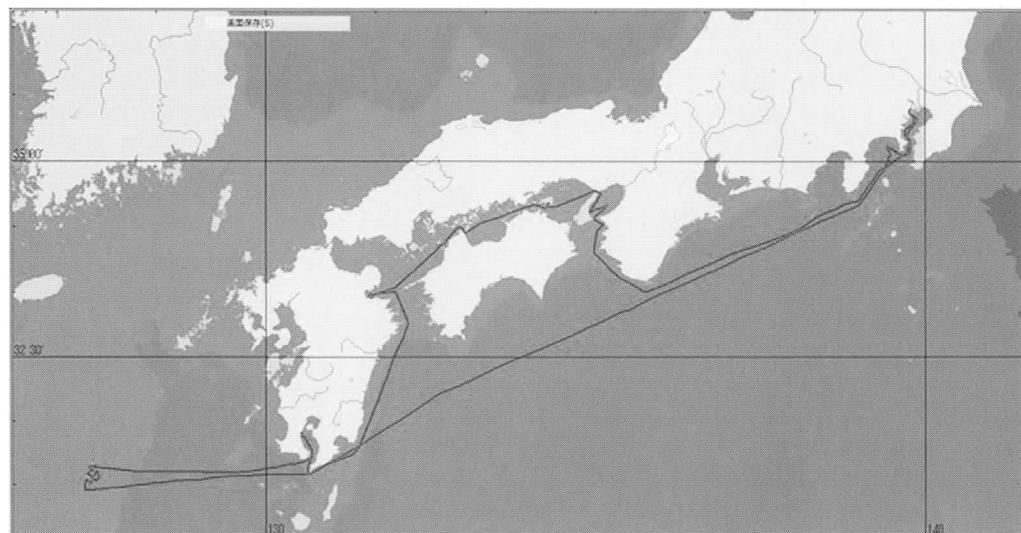


Fig. 20. Cruise track of T/V Kagoshima-maru during KG12-19.