CRUISE SUMMARY REPORT

FOR COLLATING CENTRE USE

Centre: BODC Ref. No.:

Is data exchange restricted ☐ Yes ☐ In part ☑ No

SHIP enter the full name and international radio call sign of the ship from which the data were collected, and indicate the type of ship, for example, research ship; ship of opportunity, naval survey vessel; etc.

Name: Hakuho Maru **Call Sign: JDSS**

Type of ship: Research Ship

CRUISE NO. / NAME KH-23-2 Cruise

enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate).

CRUISE PERIOD start (set sail) 1 / June / 2023 day/ month/ year to 25/ June /2023 day/ month/ year end (return to port)

PORT OF DEPARTURE (enter name and country) **Tokyo (Japan)**

PORT OF RETURN (enter name and country) **Tokyo (Japan)**

RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coordinating the scientific planning of the cruise

Name: Marine Inorganic Chemistry Lab., Atmosphere and Ocean Research Institute, Univ. Tokyo

Address: 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8564

Country: Japan

CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise.
Hajime Obata, Marine Inorganic Chemistry Lab., Atmosphere and Ocean Research Institute, Univ. Tokyo

OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so as to provide the context in which the report data were collected.

The Hakuho Maru KH-23-2 cruise, nicknamed as “Ophiuchus (OP) Expedition”, has been performed by following KH-22-7 cruise. This cruise has been internationally authorized as a part of the GEOTRACES section study in the western Pacific Ocean (GP22).

Recently, we have realized that the information on TEIs in the ocean is useful to deepen our understandings on physical, chemical and biological processes in marine environments. To predict future environmental changes caused by human activities, we also need to investigate the global distributions of biologically available chemical species of TEIs in the ocean and their exchange fluxes at the air-sea and sediment-water interfaces. However, accumulated high-quality data are not large enough to draw a global picture of marine biogeochemical cycles of TEIs. This cruise aimed at establishing the 2-dimensional profiles of GEOTRACES TEIs in the western Pacific in order to advance ocean sciences on TEIs as mentioned above. It is well known that both Oyashio and Kuroshio are strong surface currents and transport trace elements from marginal seas like the Sea of Okhotsk and the East China Sea to the western North Pacific. Moreover, atmospheric dust deposition from the Asian deserts supplies huge amounts of trace elements to the western North Pacific. However, this unique area has been partially occupied during KH-11-7 cruise (GP18) but has not been fully covered by the meridional GEOTRACES section cruises. Therefore, we decided to set 2-dimensional section observations along 155°E to investigate TEIs in seawaters and sediments of the western Pacific. This section includes subarctic Pacific known as a typical High Nutrient, Low Chlorophyll (HNLC) zone. Since we revisited the several stations in the western subarctic Pacific stations overlapping the previous stations during KH-12-4 and KH-17-3 cruises, it may be interesting to compare the data obtained this time with those in the past, revealing temporal changes in various physical, chemical and biological parameters in the western Pacific.

In order to pursue these purposes, we have taken air, seawater, and sediment samples for chemical analyses. Water samples were collected from surface to near the bottom by using a clean CTD Carousel Multi Sampling system (24 Niskin-X (12L) bottles) attached at the end of an Aramid yarn cable. For the precise measurements of trace radioactive nuclides in seawater, large-volume water samplers with a volume of 250 L were also used for seawater sampling. Bottom sediment was taken with a multiple corer. Suspended particles were taken using an in situ filtering system. In addition, we occupied one station (OP-15R, 44°N, 155°E) for repeated observation with the data obtained by the previous KH-22-7 cruise.

This cruise was originally planned as KH-22-7 cruise Leg. 3. However, because of rapid increase of oil price, we postponed the cruise in 2023. During this cruise, thirty-four scientists, technicians, and students were on board to pursue international collaborative studies on GEOTRACES. We hope that the obtained data by this cruise will play an important role in the GEOTRACES program as zonal line data in the western Pacific Ocean.

PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition), then enter the name of the project, and of organisation responsible for co-ordinating the project.

Project name: GEOTRACES (GP22 line)

Coordinating body: SCOR, Atmosphere and Ocean Research Institute (Univ. Tokyo)

PRINCIPAL INVESTIGATORS: Enter the name and address of the Principal Investigators responsible for the data collected on the cruise and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pages 2 and 3, under the column heading 'PI', to identify the data sets for which he/she is responsible)

A. **Hajime Obata (Atmosphere & Ocean Research Institute, the University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8564, JAPAN, obata@aori.u-tokyo.ac.jp)**
B. **Masafumi Murayama (Research and Education Faculty, Kochi University, B200 Monobe, Nankoku, Kochi 783–8502, JAPAN, murayama@kochi-u.ac.jp)**

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI	APPROXIMATE POSITION						DATA TYPE	DESCRIPTION
	LATITUDE			LONGITUDE				
See top of page.	deg	min	N/S	deg	min	E/W	enter code(s) from list on last page.	Identify, as appropriate, the nature of the instrumentation the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any identifiers given to the site.
								Please continue on separate sheet if necessary

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the cruise, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) BT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO, UNITS : for each data set, enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

PI see page 2	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on last page	DESCRIPTION Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e. g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
A	12	station	H09, H10, H16, H21, H22, H24, H25, H26, H27, H28, H30, H31, H32	Seawater samples were taken using a Seabird Carousel-32 Multi Bottle water sampling system containing a Seabird SBE-9plus CTD. The system was lowered from sea surface to just above the bottom, attached at the end of an Aramid yarn cable armored cable. Pre-cleaned 12L Niskin-X bottles (Teflon-coated) were used for seawater sampling. Large volume (~250 L) seawater samples were taken using a specially designed large volume water sampling system. In situ filtration was also conducted to take particulate material for chemical analyses.
B	6	core	G04	Surface sediment (20~40 cm depth) was taken using a multiple corer.
				Please continue on separate sheet if necessary

TRACK CHART: You are strongly encouraged to submit, with the completed report, an annotated track chart illustrating the route followed and the points where measurements were taken.	**Insert a tick(✔) in this box if a track chart is supplied**	✔

GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

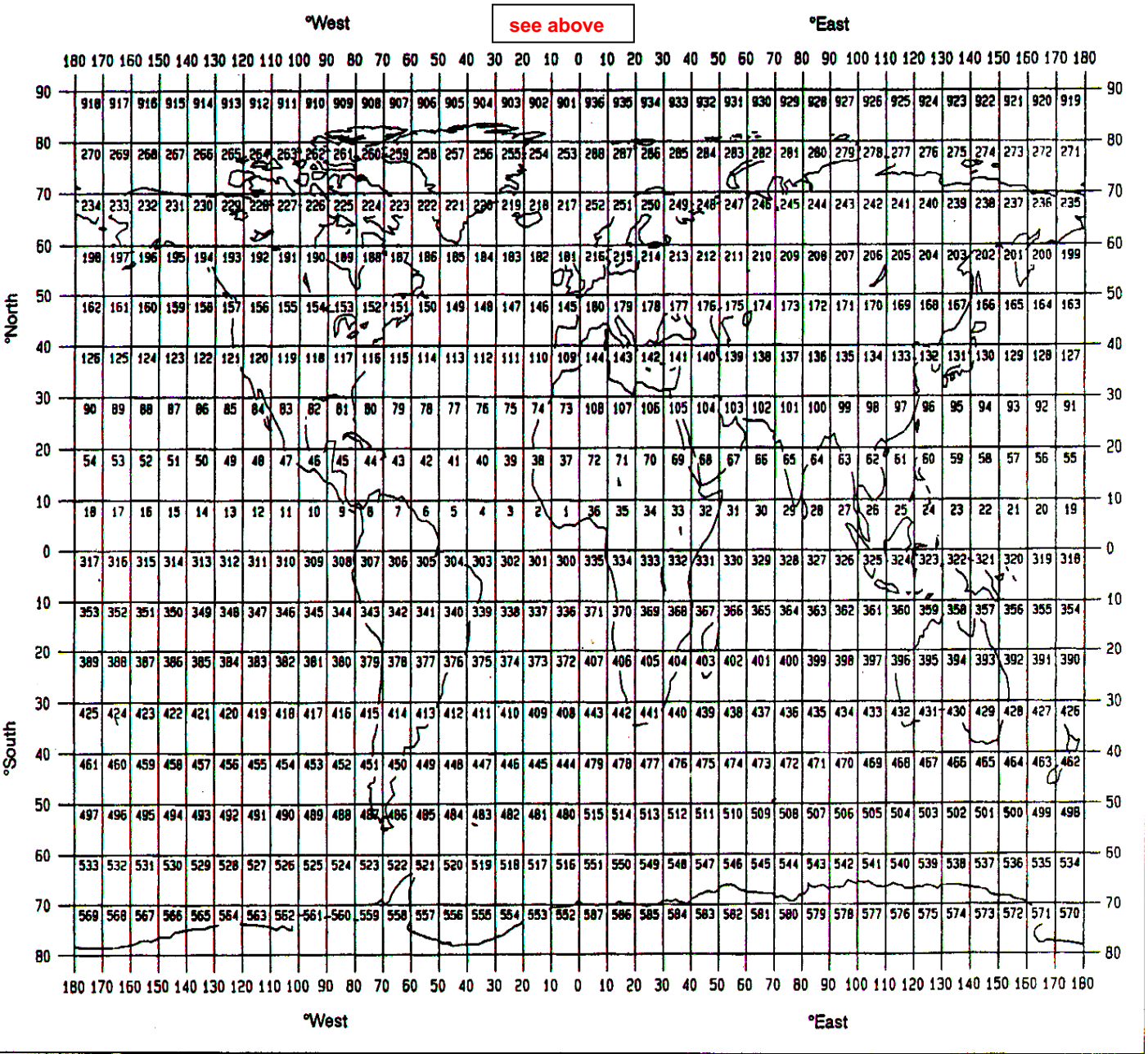
North Pacific Ocean

SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea, then enter a description of the area(s). Such descriptions may include references to local geographic areas, to sea floor features, or to geographic coordinates.

Please insert here the number of each square in which data were collected from the below given chart

129, 130, 164, 165, 200

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



THANK YOU FOR YOUR COOPERATION

Please send your completed report without delay to the collating centre indicated on the cover page

PARAMETER CODES

METEOROLOGY

M01	Upper air observations
M02	Incident radiation
M05	Occasional standard measurements
M06	Routine standard measurements
M71	Atmospheric chemistry
M90	Other meteorological measurements

PHYSICAL OCEANOGRAPHY

H71	Surface measurements underway (T,S)
H13	Bathythermograph
H09	Water bottle stations
H10	CTD stations
H11	Subsurface measurements underway (T,S)
H72	Thermistor chain
H16	Transparency (eg transmissometer)
H17	Optics (eg underwater light levels)
H73	Geochemical tracers (eg freons)
D01	Current meters
D71	Current profiler (eg ADCP)
D03	Currents measured from ship drift
D04	GEK
D05	Surface drifters/drifting buoys
D06	Neutrally buoyant floats
D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY

H21	Oxygen
H74	Carbon dioxide
H33	Other dissolved gases
H22	Phosphate
H23	Total - P
H24	Nitrate
H25	Nitrite
H75	Total - N
H76	Ammonia
H26	Silicate
H27	Alkalinity
H28	PH
H30	Trace elements
H31	Radioactivity
H32	Isotopes
H90	Other chemical oceanographic measurements

MARINE CONTAMINANTS/POLLUTION

P01	Suspended matter
P02	Trace metals
P03	Petroleum residues
P04	Chlorinated hydrocarbons
P05	Other dissolved substances
P12	Bottom deposits
P13	Contaminants in organisms
P90	Other contaminant measurements

MARINE BIOLOGY/FISHERIES

B01	Primary productivity
B02	Phytoplankton pigments (eg chlorophyll, fluorescence)
B71	Particulate organic matter (inc POC, PON)
B06	Dissolved organic matter (inc DOC)
B72	Biochemical measurements (eg lipids, amino acids)
B73	Sediment traps
B08	Phytoplankton
B09	Zooplankton
B03	Seston
B10	Neuston
B11	Nekton
B13	Eggs & larvae
B07	Pelagic bacteria/micro-organisms
B16	Benthic bacteria/micro-organisms
B17	Phytobenthos
B18	Zoobenthos
B25	Birds
B26	Mammals & reptiles
B14	Pelagic fish
B19	Demersal fish
B20	Molluscs
B21	Crustaceans
B28	Acoustic reflection on marine organisms
B37	Taggings
B64	Gear research
B65	Exploratory fishing
B90	Other biological/fisheries measurements

MARINE GEOLOGY/GEOPHYSICS

G01	Dredge
G02	Grab
G03	Core - rock
G04	Core - soft bottom
G08	Bottom photography
G71	In-situ seafloor measurement/sampling
G72	Geophysical measurements made at depth
G73	Single-beam echosounding
G74	Multi-beam echosounding
G24	Long/short range side scan sonar
G75	Single channel seismic reflection
G76	Multichannel seismic reflection
G26	Seismic refraction
G27	Gravity measurements
G28	Magnetic measurements
G90	Other geological/geophysical measurements