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Short Cruise Report SONNE 292

Nouméa (New Caledonia) - Nouméa (New Caledonia)

15.05.2022 – 21.06.2022

Chief Scientist: Christian Betzler

Captain: Oliver Meyer

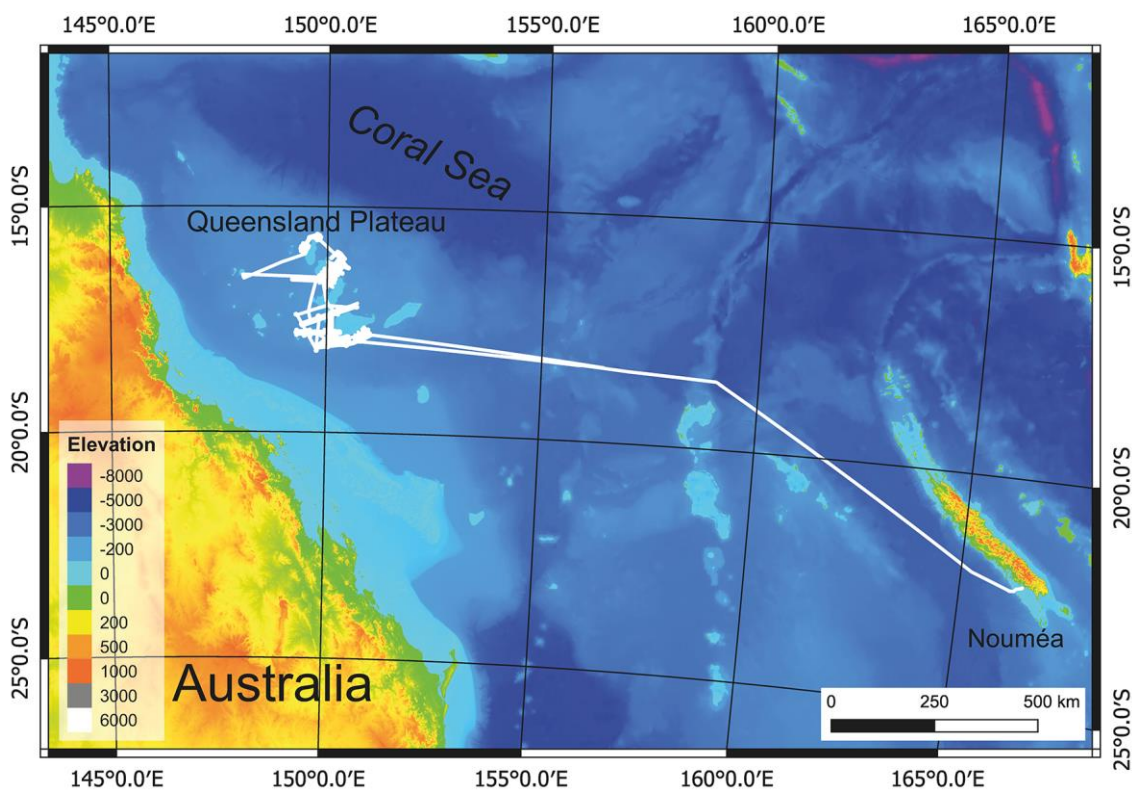


Fig. 1. Ship track of cruise SO292

Objectives

The superordinate project objective is to verify the hypothesis that tropical carbonate platforms since the onset of the middle and late Miocene global cooling are strongly controlled by ocean currents. It is proposed that the modern carbonate platforms are in an "icehouse world mode". Four aims will allow achieving this goal: By linking seismic reflection- with stratigraphic data from Ocean Drilling Program Leg 133 sites at the Queensland Plateau carbonate platform, the backstepping of carbonate bank margins will be understood. Here, the focus is on the mapping and correlation of current features such as submarine dunes, drift bodies or current moats. Recent and youngest depositional processes of the carbonate banks will be analyzed with hydroacoustic data determining ocean current impact on the carbonate source to sink system (e.g. sediment thickness distribution, slope instabilities). Sedimentary variations with regard to carbonate bank exposure to currents and wind will be analyzed via sediment composition (grain size, texture, components), linking geological and geophysical data. To assess how the carbonate banks exposed to ocean currents disturb the water mass stratification, CTD stations will be measured up- and downcurrent of the buildups.

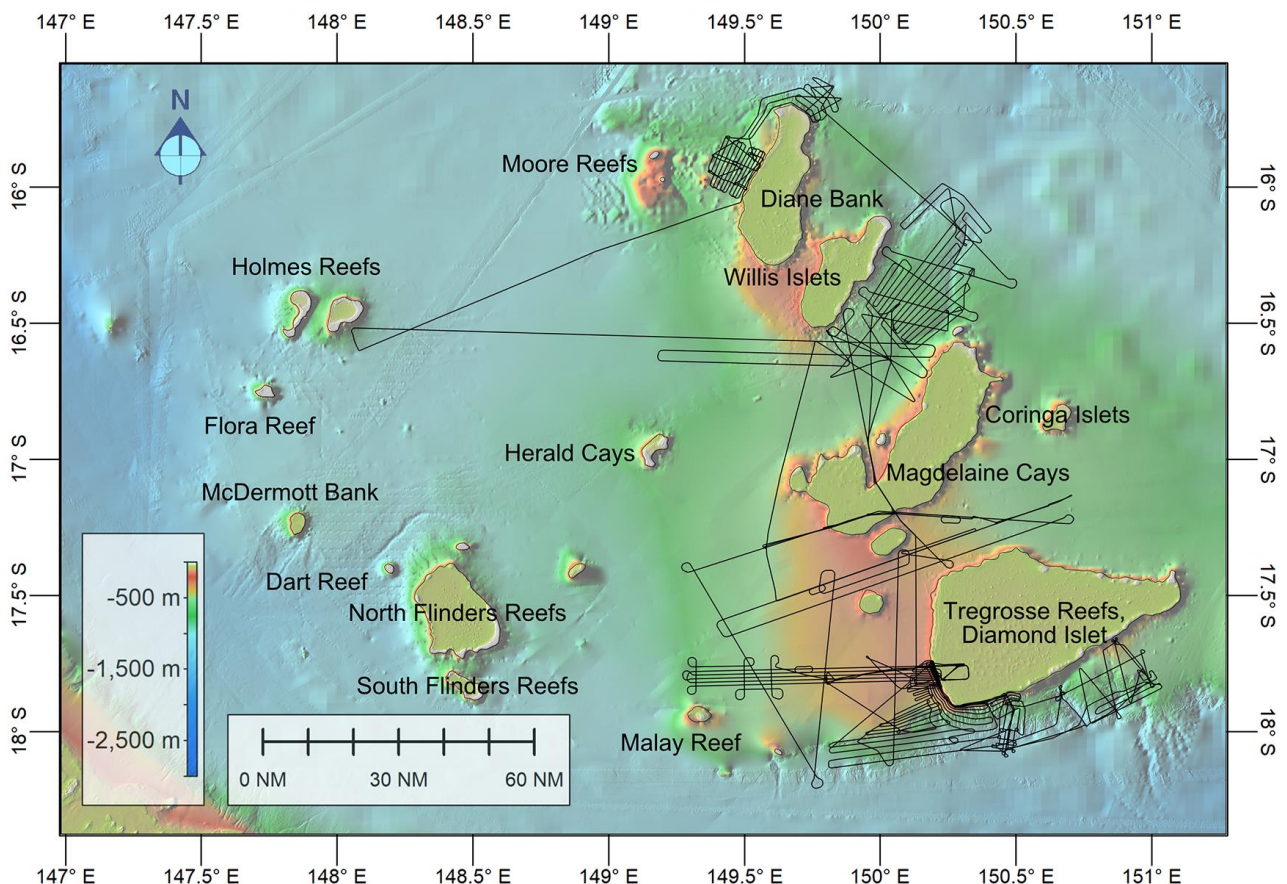


Fig. 2 Ship's tracks in the SO292 research area.

Narrative

R/V SONNE began the voyage for cruise SO292 at 22 UTC the 15th of May in Nouméa and headed NW on a three days transit to the southern flank of the Tregrosse Reefs carbonate platform located on the Queensland Plateau (Fig. 2). The boundary of the Australian EEZ was crossed at 05.45 am UTC on May 17th. Weather condition in general

were quiet, with exception of a thunderstorm in the early morning of the 17th.

On the morning of the 18th of May (20.19, 17:05. UTC) the vessel entered the first working area and after visual controls by the accompanying four mammal observers, hydroacoustic measurements started. A CTD profile was measured in a water depth of 950 m and a box core sample retrieved at a location previously determined with hydroacoustic data. Starting in the afternoon, hydroacoustic measurements were reinitiated which ended May 18th at 00:13 UTC. The digital streamer from the University of Hamburg was lowered in the water followed by the seismic sources with a primary volume of 15 and 45 cubic inches. Following the Australian national guidelines for whale and dolphin watching (2017) and the guidelines expressed in the Australian Marine Park Activity Permit PA2021-00122-1 the seismic soft-start procedure (ramp-up procedure) of the seismic sources was initiated at 05.16 UTC and the first seismic survey of the research cruise started. The survey proceeded the 20th with a short interruption for maintenance of the seismic sources and terminated the 22nd of May after recording 304 nm of seismic data. Streamer and seismic sources were retrieved and the vessel headed southeast to retrieve a short gravity core in a carbonate drift succession. No sediment, however, was retrieved due to the sandy nature of the substrate.

The night from the 22nd to 23rd of May was used to complete the hydroacoustic survey of the western edge and slope of the Tregrosse Reefs carbonate bank. During daylight time of the 23rd of May the Ocean Floor Observation System (OFOS) of RV SONNE was deployed in the inner and outer bank for a visual reconnaissance of the sea floor in order to plan for a later sediment sampling in the platform's interior. During the night from the 23rd to 24th a yo-yo CTD station was performed adjacent to the western flank of the bank in order to recover the tidal controlled water outflow (flood to ebb) of the platform.

On the early afternoon of the 23rd of May RV SONNE began a box core sampling program at locations previously defined with hydroacoustics and visual seafloor observation with the OFOS in the shallow part of the Tregrosse Reefs bank. Seven box cores were retrieved, and after a short hydroacoustic survey of the flank of the bank, the ship was positioned at 17° 45,635' S / 150° 10,611' E from 13:24 UTC the 23rd of May to 04:05 UTC on May 24th for a Jo Jo CTD. After completion of this station hydroacoustic work was resumed and RV SONNE headed east to explore the southern flank of the Tregrosse Reefs carbonate bank.

The survey was performed until the 25th of May. A ROV dive was planned for the early afternoon of the same day. After lowering the ROV into the water, however, the reconnaissance could not be started due to a technical failure of the gear. The OFOS was used instead to analyze the nature of a submarine rockfall at the southern flank of Tregrosse Reefs bank at a water depth of 530 m and deeper. After a successful visual sea floor observation over a 0.519 nm long transect a hydroacoustic survey was re-initiated which ended the morning of the 26th of May. This day, four OFOS dives were performed. Two of them covered a shallow to deep transect along the southern and western flank of the Tregrosse Reefs carbonate bank, one in a circular seafloor depression just west of the bank and one between Abington Reef and Tregrosse Reefs carbonate bank. After performing the ramp-up procedure for the seismic sources, a second seismic survey was initiated at 23:55 UTC the 28th of May. This survey brought the vessel further to the north and crossing the shallow waters of the Magdelaine Cays carbonate bank in a west to east

direction. A sighting of marine mammals (pilot whales) at 21:14 UTC the 30th of May made us interrupt the survey which was later re-initiated after the mammal observers confirmed that no more whales were sighted after 1.5 hours.

The seismic survey ended the 1st of June at 07:47 UTC. Seismic gears were retrieved from the water and the vessel headed SW for a Yo Yo CTD station located east of the Magdelaine Cays carbonate bank. After 26 hours of CTD measurements, the vessel moved towards the east to initiate a series of OFOS stations on and around Magdelaine Cays carbonate bank. After measuring a CTD station west of Magdelaine bank, the ship sailed east to initiate a further seismic survey. A planned sedimentological sampling campaign was aborted, as technical problems hindered the use of the lifting gears. The vessel moved to the next working area and seismic gears were lowered into the water and after checking for the presence of marine mammals a survey was started at 15:25 UTC the 3rd of June. The survey brought RV SONNE further north and after crossing the Magdelaine Cays carbonate bank data, were acquired in the area south and southeast of the Willis Islets platform. This seismic survey ended the 5th of June 21:03 UTC.

In the following, the vessel pursued a program of sedimentological sampling and OFOS surveying in and around the Magdelaine Cays carbonate bank. This was followed by a hydroacoustic and OFOS survey of a submarine valley located between the Magdelaine Cay and Willis Islets carbonate banks. After performing the ramp-up procedure and watching out for marine mammals, the last seismic survey of the cruise was initiated the 8th of June at 08:01 UTC. This survey brought the vessel to the westernmost zone of cruise SO292, just off Holmes Reef near the location of ODP Site 811. This last seismic survey terminated at 22:35 UTC the 9th of June and the vessel began a 81 nautical miles transit northeast toward the flanks of Diane Bank for a further hydroacoustic mapping followed by OFOS dives and sediment sampling. On the 13th of June at 07:29 UTC a further hydroacoustic survey was initiated between Willis Islets and Magdelaine Cays carbonate banks to fill in the gaps in our grid.

After performing an OFOS dive the vessel at 22:09 UTC the 14th of June headed south to the research area around Tregrosse Reefs carbonate bank to fill in some gaps in the multibeam data. A last CTD station was terminated at 04:23 UTC the 16th of June before a short sediment sampling campaign along the southern flank of the carbonate bank. The science program of the cruise SO292 ended at 00:42 UTC the 17th of June after retrieving a gravity core south of Tregrosse Reefs carbonate bank and the vessel began the return voyage to the port of Nouméa. RV SONNE entered Nouméa port on the morning of the 21st of June, and unloading of the scientific equipment started immediately.

Acknowledgements

The science team of the cruise SO292 thanks Captain Oliver Meyer, the officers and the crew of RV SONNE for their continuous and very efficient support during our expedition, and also for the pleasant working atmosphere onboard. Their expertise was one of the building blocks for our research. The Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung) is thanked for funding the cruise and the research through Grant 03G0292A. We thank the Director of National Parks Australia to allow research in the Coral Sea Marine Park through the permit PA2021-00122-1. Rob

Beaman was a great support during crucial phases of the cruise preparation. The Leitstelle Deutsche Forschungsschiffe (German Research Fleet Coordination Centre) is thanked for logistical support. The German Weather Service (DWD) is thanked for their daily reports on weather forecasts, which were highly valuable to plan the scientific data acquisition. Hanno Keil (University of Bremen) is thanked for providing the software tool ps32segy.

List of participants

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5. Bialik, Or Mordechay	Sedimentology	UM
6. Eggers, Dirk	Sedimentology / ROV	IfGeo
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17. Maul, Jacob	Sedimentology	IfGeo
18. Petrovic, Alexander	Sedimentology	KAUST
19. Pickering, Joseph	Mammal Observer	OE
20. Reolid Pérez, Jesús	Sedimentology / OFOS	UGR
21. Saitz, Yannick Marvin	Seismics	IfGeo
22. Schmidt, Maryse Charlotte	Seismics	IfG
23. Schönbeck, Frederik	Sedimentology	IfGeo
24. Schwarz, Tom	Sedimentology	IfGeo
25. Sparkes, Emily Grace	Mammal Observer	OE
26. Strehse, Victoria Cristl	Hydroacoustics	IfGeo
27. Wasilewski, Thomas	Sedimentologie	IfM
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UM	Department of Geosciences, Faculty of Science, University of Malta, Msida MSD 2080, Malta
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UGR	Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Avenida de la Fuente Nueva S/N, 18071 Granada, Spain
OE	Ocean Ecology - Main Office, River Office, Severnside Park, Epney, Gloucester, GL2 7LN, United Kingdom

List of stations

Station	Date & Time [UTC]	Lat. S	Lon. E	Device	Depth [m]
SO292_1-1	17.05.2022 20:19	17° 58.873'	150° 45.614'	MBES+PS70	1199
SO292_2-1	17.05.2022 22:53	17° 50.744'	150° 39.846'	CTD	970
SO292_3-1	18.05.2022 00:59	17° 52.130'	150° 39.994'	BC	1016
SO292_4-1	18.05.2022 02:35	17° 51.833'	150° 40.079'	MBES+PS70	942
SO292_5-1	19.05.2022 07:32	17° 47.204'	150° 11.673'	SEISMIC	136
SO292_6-1	20.05.2022 02:28	17° 46,738'	149° 57,165'	XSV	340
SO292_7-1	22.05.2022 05:28	17° 48.529'	149° 49.879'	GC	379
SO292_8-1	22.05.2022 07:19	17° 46.193'	150° 03.542'	MBES+PS70	293
SO292_9-1	22.05.2022 21:05	17° 45.420'	150° 18.345'	OFOS	55
SO292_10-1	22.05.2022 23:17	17° 45.495'	150° 16.946'	OFOS	58
SO292_11-1	23.05.2022 01:53	17° 48.700'	150° 13.987'	OFOS	53
SO292_12-1	23.05.2022 04:45	17° 45.618'	150° 11.535'	OFOS	70
SO292_13-1	23.05.2022 06:45	17° 45.990'	150° 10.234'	OFOS	253
SO292_14-1	23.05.2022 08:53	17° 45.926'	150° 10.308'	BC	252
SO292_14-2	23.05.2022 09:31	17° 45.928'	150° 10.307'	BC	252
SO292_15-1	23.05.2022 09:57	17° 45.735'	150° 10.391'	MBES+PS70	250
SO292_16-1	23.05.2022 13:24	17° 45.639'	150° 10.607'	CTD	242
SO292_17-1	24.05.2022 05:17	17° 45.425'	150° 18.514'	BC	52
SO292_18-1	24.05.2022 05:53	17° 45.430'	150° 18.455'	BC	52
SO292_19-1	24.05.2022 06:27	17° 45.429'	150° 18.432'	BC	52
SO292_20-1	24.05.2022 06:57	17° 45.437'	150° 18.360'	BC	55
SO292_21-1	24.05.2022 07:33	17° 45.503'	150° 17.207'	BC	58
SO292_22-1	24.05.2022 08:21	17° 48.710'	150° 14.112'	BC	51
SO292_23-1	24.05.2022 09:15	17° 45.633'	150° 11.651'	BC	66
SO292_24-1	24.05.2022 09:30	17° 45.676'	150° 11.659'	MBES+PS70	64
SO292_25-1	25.05.2022 01:33	17° 59.731'	150° 24.293'	MBES+PS70	981
SO292_26-1	25.05.2022 16:10	17° 52.271'	150° 40.055'	OFOS	1019
SO292_27-1	25.05.2022 17:59	17° 52.431'	150° 40.255'	MBES+PS70	1009
SO292_28-1	26.05.2022 03:51	17° 46.561'	150° 58.254'	ROV	533
SO292_29-1	26.05.2022 04:57	17° 46.557'	150° 58.258'	OFOS	533
SO292_30-1	26.05.2022 07:46	17° 46.886'	150° 56.959'	MBES+PS70	518
SO292_31-1	26.05.2022 22:28	17° 40.284'	150° 52.091'	OFOS	348
SO292_32-1	27.05.2022 02:06	17° 46.563'	150° 58.257'	BC	532
SO292_33-1	27.05.2022 03:39	17° 49.241'	150° 59.571'	GC	694
SO292_34-1	27.05.2022 07:56	18° 03.990'	150° 28.074'	BC	1143
SO292_34-2	27.05.2022 09:21	18° 03.988'	150° 28.058'	GC	1143
SO292_35-1	27.05.2022 11:18	17° 59.755'	150° 28.554'	BC	1034
SO292_36-1	27.05.2022 12:52	17° 59.715'	150° 28.268'	BC	998
SO292_37-1	27.05.2022 14:22	18° 04.897'	150° 27.610'	MBES+PS70	1171
SO292_38-1	28.05.2022 00:49	17° 51.823'	150° 27.617'	OFOS	63
SO292_39-1	28.05.2022 05:29	17° 45.654'	150° 11.510'	ROV	72
SO292_39-2	28.05.2022 06:10	17° 45.630'	150° 11.507'	OFOS	76
SO292_40-1	28.05.2022 10:59	17° 48.302'	149° 48.109'	OFOS	395

Station	Date & Time [UTC]	Lat. S	Lon. E	Device	Depth [m]
SO292_40-2	28.05.2022 12:47	17° 48.437'	149° 48.174'	GC	493
SO292_41-1	28.05.2022 15:41	17° 59.815'	150° 04.252'	OFOS	446
SO292_42-1	28.05.2022 17:40	17° 59.826'	150° 04.299'	MBES+PS70	446
SO292_43-1	28.05.2022 23:52	18° 06.899'	150° 02.879'	SEISMIC	851
SO292_44-1	30.05.2022 01:19	18° 05,283'	149° 43,071'	XSV	821
SO292_45-1	31.05.2022 00:01	17° 12,958'	150° 21,909'	XSV	470
SO292_46-1	02.06.2022 11:03	17° 10.208'	150° 37.225'	CTD	597
SO292_47-1	02.06.2022 13:26	17° 14.290'	150° 25.558'	OFOS	483
SO292_48-1	02.06.2022 15:31	17° 12.884'	150° 20.636'	OFOS	467
SO292_49-1	02.06.2022 19:26	17° 11.687'	150° 03.030'	OFOS	60
SO292_50-1	02.06.2022 21:38	17° 12.152'	149° 57.348'	OFOS	53
SO292_51-1	03.06.2022 00:21	17° 15.012'	149° 48.602'	OFOS	65
SO292_52-1	03.06.2022 03:22	17° 19.562'	149° 34.539'	CTD	506
SO292_53-1	03.06.2022 06:05	17° 31.250'	149° 37.349'	ADCP	434
SO292_54-1	03.06.2022 15:28	17° 23.470'	150° 14.395'	SEISMIC	355
SO292_55-1	04.06.2022 20:56	16° 23,678'	150° 13,951'	XSV	805
SO292_56-1	06.06.2022 00:33	16° 38.162'	150° 02.441'	BC	643
SO292_57-1	06.06.2022 04:05	17° 05.373'	149° 59.120'	ROV	160
SO292_57-2	06.06.2022 05:02	17° 05.626'	149° 59.402'	OFOS	56
SO292_58-1	06.06.2022 07:35	17° 11.715'	150° 03.087'	BC	86
SO292_59-1	06.06.2022 08:37	17° 12.135'	149° 57.497'	BC	57
SO292_60-1	06.06.2022 10:08	17° 15.436'	149° 47.425'	CTD	293
SO292_60-2	06.06.2022 11:01	17° 15.439'	149° 47.422'	BC	292
SO292_61-1	06.06.2022 12:58	17° 19.560'	149° 34.541'	GC	507
SO292_62-1	06.06.2022 17:25	16° 34.058'	149° 45.975'	MBES+PS70	444
SO292_62-2	07.06.2022 04:12	16° 27.864'	150° 15.115'	MBES+PS70	815
SO292_62-3	07.06.2022 07:35	16° 18.000'	150° 20.749'	MBES+PS70	834
SO292_63-1	07.06.2022 03:36	16° 27.863'	150° 15.111'	BC	815
SO292_64-1	07.06.2022 06:41	16° 19.452'	150° 20.007'	GC	812
SO292_65-1	07.06.2022 10:59	16° 12.026'	150° 18.593'	CTD	975
SO292_65-2	07.06.2022 12:23	16° 12.023'	150° 18.591'	OFOS	968
SO292_66-1	07.06.2022 14:23	16° 11.551'	150° 19.098'	MBES+PS70	952
SO292_67-1	08.06.2022 02:34	16° 38.165'	150° 02.438'	CTD	642
SO292_67-2	08.06.2022 03:39	16° 38.163'	150° 02.444'	GC	643
SO292_68-1	08.06.2022 08:02	16° 39.475'	149° 51.688'	SEISMIC	525
SO292_69-1	09.06.2022 20:59	16° 31,360'	148° 14,001'	XSV	956
SO292_70-1	10.06.2022 08:45	16° 02,881'	149° 29,345'	MBES+PS70	401
SO292_70-2	11.06.2022 04:54	15° 49,163'	149° 26,089'	MBES+PS70	686
SO292_71-1	11.06.2022 04:19	15° 49,163'	149° 26,088'	CTD	686
SO292_72-1	11.06.2022 06:09	15° 54,500'	149° 32,880'	XSV	427
SO292_73-1	11.06.2022 11:49	15° 41,507'	149° 40,656'	MBES+PS70	552
SO292_74-1	12.06.2022 02:18	15° 54,258'	149° 32,218'	CTD	462.13
SO292_75-1	12.06.2022 03:47	15° 53,183'	149° 32,998'	OFOS	446
SO292_76-1	12.06.2022 07:26	15° 59,521'	149° 27,949'	OFOS	536

Station	Date & Time [UTC]	Lat. S	Lon. E	Device	Depth [m]
SO292_77-1	12.06.2022 11:43	15° 57,677'	149° 24,095'	BC	667
SO292_77-2	12.06.2022 12:38	15° 57,678'	149° 24,095'	GC	668
SO292_78-1	12.06.2022 14:13	15° 56,004'	149° 29,570'	BC	506
SO292_78-2	12.06.2022 15:02	15° 56,004'	149° 29,568'	GC	505
SO292_79-1	12.06.2022 16:27	15° 54,419'	149° 27,872'	BC	607
SO292_80-1	12.06.2022 22:36	15° 38,069'	149° 45,023'	GC	941
SO292_81-1	13.06.2022 00:10	15° 37,780'	149° 49,663'	CTD	1013
SO292_82-1	13.06.2022 02:05	15° 42,994'	149° 47,190'	BC	805
SO292_82-2	13.06.2022 03:07	15° 42,995'	149° 47,187'	GC	803
SO292_83-1	13.06.2022 07:29	16° 10,871'	150° 19,289'	MBES+PS70	958
SO292_84-1	14.06.2022 10:42	16° 26,052'	150° 04,023'	OFOS	667
SO292_85-1	14.06.2022 13:42	16° 27,148'	149° 59,957'	MBES+PS70	620
SO292_86-1	15.06.2022 04:19	17° 51,317'	150° 06,613'	MBES+PS70	345
SO292_87-1	16.06.2022 03:52	17° 52,028'	150° 27,846'	CTD	329
SO292_88-1	16.06.2022 05:28	17° 55,084'	150° 29,656'	OFOS	761
SO292_89-1	16.06.2022 08:19	17° 59,729'	150° 28,358'	OFOS	995
SO292_90-1	16.06.2022 10:36	17° 59,716'	150° 28,265'	GC	999
SO292_91-1	16.06.2022 12:49	18° 04,264'	150° 17,785'	BC	1103
SO292_91-2	16.06.2022 14:20	18° 04,258'	150° 17,787'	BC	1102
SO292_92-1	16.06.2022 16:36	18° 04,428'	150° 27,035'	GC	1160
SO292_93-1	16.06.2022 19:47	17° 58,769'	150° 45,547'	BC	1195
SO292_94-1	16.06.2022 22:06	17° 55,366'	150° 52,088'	BC	1378
SO292_95-1	17.06.2022 00:11	17° 49,448'	150° 59,217'	GC	710

Abbreviations

BC	Box corer
CTD	Sonde to measure electrical conductivity, temperature, and pressure of seawater (D = water depth)
GC	Gravity corer
ADCP	Acoustic Doppler current profiler
MBES	Multibeam echosounder
OFOS	Ocean-floor observation system
PS70	PARASOUND, parametric sediment echosounder
ROV	Remotly operated vehicle
SVP	Sound velocity profile
XSV	Expendable Sound Velocity probe