

FRANKLIN

National Facility
Oceanographic Research Vessel

THE CLIMATIC EVOLUTION OF THE EASTERN INDIAN OCEAN IN THE VICINITY OF AUSTRALIA

RV FRANKLIN

CRUISE FR 02/96

Sail: Fremantle, WA 1000 hours Wednesday February 21, 1996
Arrive: Dampier, WA 1000 hours Wednesday March 6, 1996

CHIEF INVESTIGATOR

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April 96

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Franklin Cruise FR 2/96

CRUISE REPORT

"The climatic evolution of the eastern Indian Ocean in the vicinity of Australia",
and the modern distribution and chemistries of planktic and benthic organisms
for the interpretation of deep-sea cores

Sailed Fremantle 1000h, 21 February 1996
Arrived Dampier 1000h, 6 March 1996

Principal Investigator

Dr. Patrick De Deckker, cruise leader

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Dr Christian Hass, University College London & GEOMAR, Kiel, Germany
Mr David Ryan, ANU
Mr Kyoma Takahashi, Hokkaido University
Ms Wang Xuan, Monash University

Original scientific objectives of the cruise

The primary goal of the proposed research project was to obtain information present-day conditions which can be applied to the fossil record in order to better assess the climatic history of the Australian region and global palaeoenvironmental changes. The interpretation of palaeoclimatic changes throughout the Cenozoic is based largely on microfossils, such as foraminifera, and the chemistries of their tests. The research cruise involved a combination of multidisciplinary techniques, using relatively new, innovative ones to obtain valuable information from benthic and planktic foraminifera, ostracods, pteropods, nannoplankton, diatoms, and radiolarians which will be used to decipher past conditions of the oceans. The results of this research will make a significant contribution to our understanding of the ecology and palaeoecology of marine micro-organisms and their use as indicators of changes in palaeoenvironmental conditions. The following specific objectives are to collectively achieve this goal.

1) Determine the ecology and palaeoecology of planktic foraminifera, radiolarians, diatoms and calcareous nannoplankton, as well as benthic foraminifera and ostracod species found in the eastern Indian Ocean. Information about the ecology of these organisms is essential for accurate assessment of fossil assemblages. This is especially relevant for Quaternary and Holocene fossil assemblages, as most of the species found in these assemblages are also found in modern oceans.

2) Measure trace-element chemistries of planktic foraminifera as well as benthic foraminifera and ostracoda, which have been used as indicators of important oceanic conditions, including productivity.

3) Establish the relationship between the distributions of benthic organisms and environmental parameters such as sediment type, amount of organic carbon in the sediments and bottom-water oxygen levels. Currently no detailed modern ecological information is available for many meiofaunal taxa, including benthic foraminifera, from Australian waters because the vast majority of recent ecological research has focused on populations from the Northern Hemisphere.

4) Interpret the late-Glacial and Holocene climatic history of the eastern Indian Ocean near Australia. It will be possible to apply the information obtained from modern assemblages to fossil assemblages from core material taken in the eastern Indian Ocean to assess palaeoceanographic changes in surface- and bottom-water conditions, productivity, and the related effects of these changes on past global CO₂ budget and climate. Sediment cores from the same areas where the modern data were collected would be used to assess ancient climatic conditions over the last 25,000 years in the Australian region. In particular, our laboratory is focussing on the mid-Holocene warm phase which is recognised in the oceans worldwide, and which may represent an analogue for the predicted warming to occur under the future "Greenhouse Effect".

SAMPLING

Gravity cores:

During the cruise, we collected 29 gravity cores from a wide range of water depths (344 - 4089 m) between Fremantle and Geraldton, and then from the Cuvier Plateau, the northern end of the Exmouth Plateau, the Roo and Sunda Rises (south of the Indonesian EEZ), the Wombat Plateau, and finally at shallow depths between the Wombat Plateau and Dampier. The cruise track is presented in the enclosed map and details of the coring sites are available in the enclosed extensive table. The top of each gravity cores was sampled for the establishment of a dataset relating organisms remains and conditions at the sea surface. Towards the end of the cruise, we endeavoured to obtain longer cores by using an extension on the gravity corer, and were subsequently successful at obtaining several cores longer than 6 m, with a record length of 7.08m!

CTD profiles:

A total of 37 CTD profiles were selected along the cruise track in order to determine characteristics of the water masses in the vicinity of the coring sites so as to better interpret the palaeoenvironmental data to be obtained from the cores. 26 shallow-depth profiles were taken so as to obtain water quality data of relevance to the calcareous nannoplankton flora filtered at selected depths from the same waters collected in the Niskin bottles from the CTD. 11 deep CTD profiles were also taken so as to better define characteristics of the water masses encountered in the eastern Indian Ocean. Of relevance was to better define the water masses which are in contact with the sea floor cored at various depths during the cruise. Over 100 samples of water obtained from the CTD profiles were taken for trace-element, stable isotopes of oxygen and carbon for analyses to be done at ANU. We are extremely grateful to Mr Ron Plaschke, ORV staff] for having measured oxygen, salinity, NO₃+NO₂, SiO₂ and PO₄ on many of the samples taken from the CTD profiles.

Plankton samples:

During the cruise, we collected 28 vertical plankton tows (using a Clark-Bumpus net with an open and close-up system) from the upper 200m of the water column, at various depth intervals, in order to determine the distribution of plankton within the upper parts of the water column. CTD profiles were taken at the same locations as those vertical tows so as to determine the salinity, temperature and dissolved oxygen characteristics of the water column from which plankton collections were made.

In addition, we collected 32 surface plankton tows as well as water samples for chemical analyses of trace metals and stable isotopes. At the same sites, we did filter out calcareous nannoplankton and siliceous micro-organisms from 5 litres of surface water.

Cruise Track

The cruise track corresponded fairly well to the original itinerary except that, halfway through the cruise, we decided not to go over the Wallaby Plateau so as to remain on schedule. At that time, we had encountered delays caused by the malfunctioning of the gravity corer. We had anticipated from our data gathered during the last portion of cruise FR 10/95 that the area between Geraldton and Fremantle would be poor in soft bottom-sediment as a result of significant bottom erosion. Hence, during that early stage of the cruise, we retrieved very short (usually less than 1 metre in length) cores along this north-south transect, and also damaged numerous core catchers. We are very grateful to the ORV engineers, and in particular Mr Michael Culpeper, who ingeniously repaired our corer and manufactured new core catchers which proved to function extremely well.

Results

The cruise was a great success as we retrieved more plankton tows, water samples and CTD profile data than originally planned. We returned with less gravity cores than expected, but we are very satisfied with the material obtained, especially since we obtained a significant number of cores in crucial locations for palaeoenvironmental reconstructions.

It is relevant to note that we were very fortunate with the weather which was characterised by very smooth seas most of the time, and this helped towards the success of the coring operation. Significant [preliminary] results gathered onboard indicate an overall very low sedimentation rate throughout the region cored. On average, the last 100,000 years of sedimentation is represented within the upper 2 metres of each core!

In addition, three major sediment provinces are recognised along a north south transect: the Roo and Sunda Rises are characterised by radiolarian oozes[grey in colour] rich in pyrite, the latter being a byproduct of an enrichment in surface productivity. To the south of this area, the sediments consist of pink-brown foraminiferal sands. Finally, along the Western Australian coast, the cores characteristically consist of white-beige, calcareous nannoplankton ooze and fine-grained foraminiferal sands. However, the Late Quaternary sedimentary pile in this latter region is very thin (<1m) and rests on dehydrated and hard (and impenetrable) white oozes.

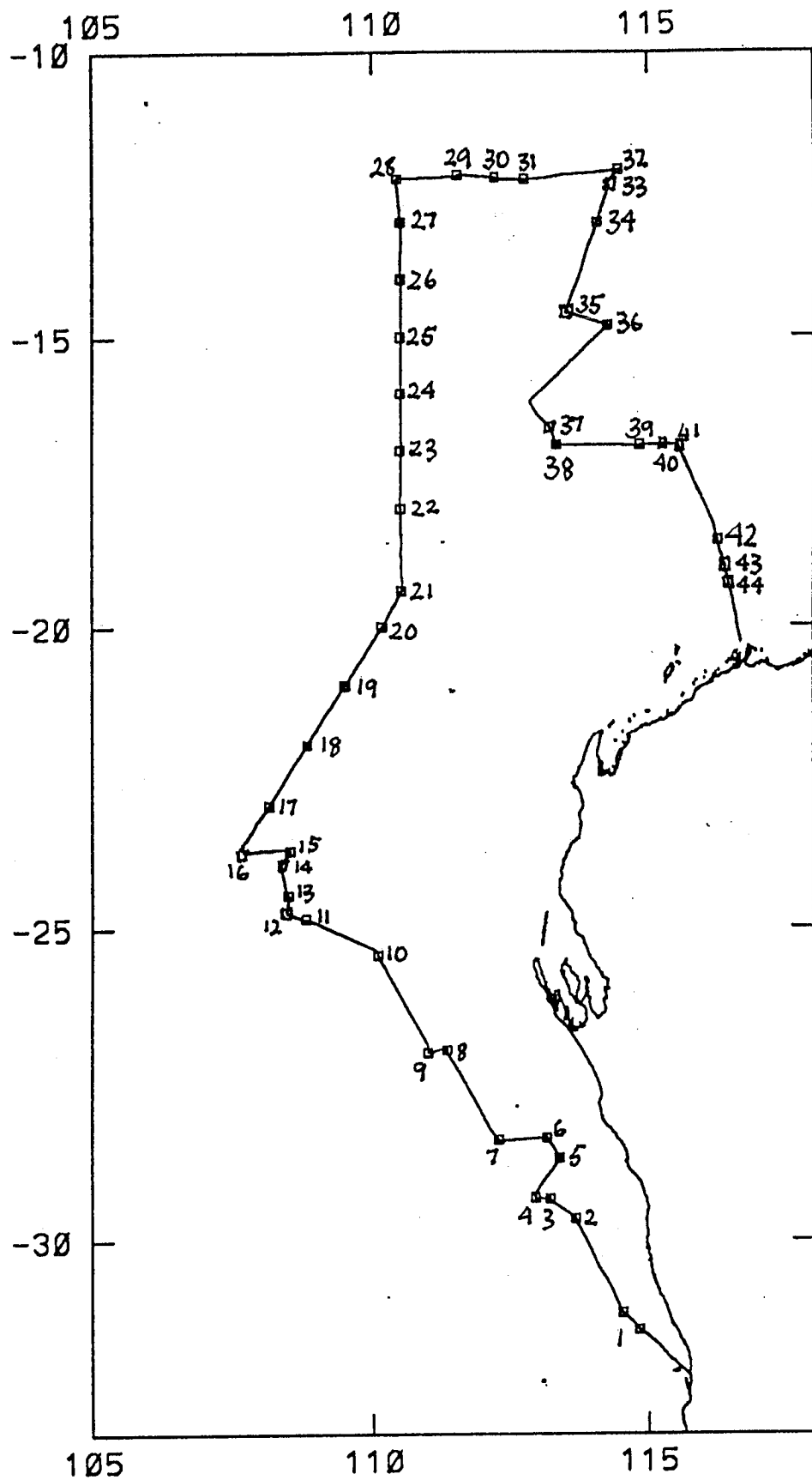
Personnel

We formed an excellent working group, and this permitted efficient processing of the samples during the entire cruise. Care was also taken throughout to maintain safety during the coring operation. The Franklin crew played an important role in this respect and were extremely helpful in all respect of the operation. We are extremely grateful to Jeff Dunn and Eric Madsen for the role they took to ensure the good coordination of the work procedures, to help provide the important data and running of the CTD profiles. These two members of staff were always available to help, give advice and reassure us at time of uncertainty.

Acknowledgments

On behalf of the entire scientific party, I wish to thank the RV Franklin Steering Committee for having allowed us to participate on this cruise. We all gained substantial experience at sea, plus gathered a large amount of extremely valuable data and samples. We are thankful also for having received the help of Mr Ron Plaschke who performed numerous chemical analyses on the samples obtained from the CTD profiles.

We wish to acknowledge the friendliness of the entire crew under the captainship of Master Ian Sneddon. The entire staff showed an interest in our scientific activities, and was always keen to help and assure success of our endeavours. We can only praise the cooperation of the entire crew and the CSIRO personnel.



**FR2-96 Cruise Track
21 Feb.-6 March 1996**

The Australian Marine Quaternary Program

RV FRANKLIN -Cruise 2/96, Perth to Dampier
February 21 1996 - March 6 1996

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Station List

Station	date (local)	time (local)	time (UTC)	lat. (°S)	long. (°E)	water depth (m, sound)	water depth (m, cable)	SSS (‰)	SST (°C)	corer	recovery (cm)	CTD	plankton/ water sample	remarks	
1	21.2.96	18:03	10:03	31°06.64"	114°32.89"	2530.0	2648.0	35.71	23.51	GC-1	64.0			very hard white-grey-green sediment	
		~20:30	~12:30	31°06.20"	114°32.18"			35.60	22.94				CTD-1	core catcher: 14cm CTD (2576m), 18-O + metals samples taken	
		21:50	13:50	31°06.11"	114°31.54"									R. #3 (=1500m) was leaking-> ignore data!	
		22:46	14:46	31°06.12"	114°31.55"								CTD-2	bottle test, 846m	
2	22.2.96													down to 200m for nanno	
		23:05	15:05	31°05.91"	114°31.41"			35.81	23.09					surface (bucket) water sample + nanno+diatom	
		~8:00	~0:00	29°40.25"	113°40.87"	2572.0		35.69	23.43	GC	0.0			plankton tow 12 min unsuccessful, core catcher damaged	
		10:33	2:33	29°39.91"	113°40.52"			35.70	23.42				CTD -4	CTD (2352m), 18-O + metals samples taken	
3		12:16	4:16	29°39.32"	113°40.47"			35.80	23.54					CTD (2352m), 18-O + metals samples taken	
														surface (bucket) water sample + nanno+diatom	
															plankton tow 12 min
		15:16	7:16	29°22.34"	113°13.02"	2895.0	3028.0	35.80	23.26	GC	0.0			unsuccessful, core catcher broken, valve repaired as possible cause for loss of sed.	
4	22.2.96	15:30	7:30	29°22.34"	113°13.02"		3028.0	35.80	23.26					surface (bucket) water sample + nanno+diatom	
		16:36	8:36	29°20.78"	113°13.00"			35.80	23.26					down to 200m for nanno	
				29°19.66"	113°13.50"			35.80	23.12					plankton tow 10 min	
				29°19.66"	113°13.50"			35.80	23.12					plankton haul 0-40, 50-200	
5	23.2.96	19:19	11:19	29°20.95"	112°56.91"	3377.0	3526.0	35.91	22.90	GC-2	82.5			core catcher damaged; valve improved	
		19:20	11:20	29°20.95"	112°56.91"			35.87	22.91					surface (bucket) water sample + nanno+diatom	
				29°19.84"	112°56.86"			35.80	22.76					CTD-6	CTD (3352m), 18-O + metals samples taken
		23:40	15:40	29°17.78"	112°56.58"	3343.0	~3400	35.85	22.83	GC-3	61.0			hard sediment; core catcher + valve work ok	
6														plankton haul 0-40, 40-200	
		1:20	17:20	29°16.29"	112°56.35"			35.85	22.79					plankton tow 11 min; weight attached => better position	
		5:40	21:40	28°43.02"	113°23.32"	935.5	953.0	35.40	24.54	GC-4	555.0			cc slightly deformed, 1m standing out of tube	
		5:58	21:58	28°42.82"	113°23.28"			35.40	24.54					CTD-7	CTD (932m), 18-O + metals samples taken
7		6:45	22:45	28°42.52"	113°23.33"			35.41	24.50					surface (bucket) water sample + nanno+diatom	
		6:45	22:45	28°42.52"	113°23.33"			35.41	24.50					plankton haul 0-60, 60-200 (LC and ICW)	
		7:03	22:45	28°42.52"	113°23.33"			35.41	24.50					plankton tow 12 min	
		9:50	1:50	28°23.55"	113°09.57"	735.0	751.0	35.31	25.08	GC-5	180.0			core catcher badly damaged	
8	24.2.96			28°23.31"	113°09.58"									CTD-8	CTD (720m), 18-O + metals samples taken
		11:15	3:15					35.32	25.05					plankton haul 0-70, 70-200	
		11:25	3:25					35.32	25.05					plankton tow 12 min	
		16:15	6:15	28°25.21"	112°17.37"	3575.0	3641.5	35.27	25.30	GC-6	90.0			compact sediment	
9		16:15	6:15	28°25.58"	112°17.96"			35.25	25.30					surface (bucket) water sample + nanno+diatom	
		18:01	10:01	28°24.87"	112°16.93"			35.13	25.50					CTD-9	CTD (3662m), 18-O + metals samples taken
		20:20	12:20	28°24.35"	112°14.93"			35.19	25.38					plankton haul 0-60, 60-200	
		20:39	12:39	28°24.35"	112°14.93"			35.19	25.38					plankton tow 10 min	
10														core catcher inverted; valve is being repaired	
		5:45	21:45	26°58.76"	111°20.13"	3090.0	3241.0	35.52	24.44	GC-7	173.5			CTD-10	0-250, nanno only
		7:20	23:20	27°00.02"	111°00.05"			35.50	24.54					surface (bucket) water sample + nanno+diatom	
		7:20	23:20	26°56.46"	111°19.66"			35.53	24.34					plankton haul 0-40, 40-200	
11		7:40	23:40	26°56.46"	111°19.66"			35.53	24.34					plankton haul 0-40, 40-200	
		7:54	23:54	26°56.46"	111°19.66"			35.53	24.34					plankton tow 10 min	

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RV FRANKLIN -Cruise 2/96, Perth to Dampier

February 21 1996 - March 6 1996

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Station List

Station	date (local)	time (local)	time (UTC)	lat. (°S)	long. (°E)	water depth (m, sound)	water depth (m, cable)	SSS (‰)	SST (°C)	corer	recovery (cm)	CTD	plankton/ water sample	remarks
9		10:09	2:09	27°00.01"	111°00.29"	3947.5		35.49	24.54			CTD-11		CTD (3972m), 18-O + metals samples taken
		10:09	2:09	27°00.01"	111°00.29"								surface (bucket)	water sample + nanno+diatom
		12:30	4:30	26°59.34"	111°00.51"			35.44	24.66				plankton haul	0-50, 50-200
		12:50	4:50	26°59.34"	111°00.51"			35.44	24.66				plankton tow	10 min
10		22:45	14:45	25°23.02"	110°05.52"	3816.0	4000.4	35.41	25.31	GC	0.0			core catcher inverted, flap didn't work
		22:55	14:55	25°23.02"	110°05.52"			35.41	25.31				surface (bucket)	water sample + nanno+diatom
	25.2.96	0:42	16:42	25°25.66"	110°05.97"			35.44	25.25			CTD-12		0-200, nanno only
		0:57	16:57	26°25.32"	110°05.58"			35.47	25.15				plankton haul	0-70, 70-200
				26°25.32"	110°05.58"			35.47	25.15				plankton tow	10 min
		2:00	18:00	25°24.06"	110°05.95"	3839.5	4000.9			GC	0.0			attempt with new rubber flap unsuccessful
11		11:20	3:20	24°50.76"	108°49.48"	2670.0		34.42	24.88	GC-8	77.0			new core catcher
		12:30	4:30	24°51.06"	108°48.73"			35.38	25.02			CTD-13		CTD (2670m), 18-O + metals samples taken
		13:00	5:00	24°51.34"	108°48.48"			35.50	24.97				surface (bucket)	water sample + nanno+diatom
		14:00	6:00	24°51.34"	108°48.48"			35.50	24.97				plankton haul	
		14:20	6:20	24°51.34"	108°48.48"			35.50	24.97				plankton tow	10 min
12		16:55	8:55	24°44.83"	108°29.26"	2534.0	2596.0	35.54	24.85	GC-9	153.0			core catcher-rubber glove system; no other
13		19:30	11:30	24°27.85"	108°30.61"	2852.0	2909.0	35.43	24.85	GC-10	217.0			none
		19:37	11:37	24°28.07"	108°30.91"			35.45	24.84				surface (bucket)	water sample + nanno+diatom
		21:00	13:00	24°28.07"	108°30.91"							CTD-14		CTD down to 200m (18O, metals)
		21:19	13:19	24°27.49"	108°29.80"			35.57	24.85				plankton haul	0-50, 50-200
		21:30	19:30	24°27.49"	108°29.80"			35.57	24.85				plankton tow	10 min
14	26.2.96	0:50	16:50	23°57.16"	108°22.14"	2404.0	2452.0	35.46	24.66	GC-11	132.0			none; no other data
15		4:05	20:05	23°44.23"	108°31.91"	2100.0	2151.6	35.23	25.39	GC-12	223.0			none; no other data
		4:45	20:45	23°44.04"	108°31.92"			35.24	25.33				surface (bucket)	water sample + nanno+diatom
		5:03	21:03	23°43.40"	108°31.82"			35.24	25.30			CTD-15		CTD down to 200m (18O, metals)
		5:03	21:03										plankton haul	0-40, 40-200
		5:20	21:20										plankton tow	10 min
16		10:44	2:44	23°43.75"	107°42.71"	3189.0	3261.0	35.55	24.44	GC-13	22.0			core catcher damaged (one of the old ones)
17		16:50	8:50	23°00.19"	108°10.03"	3748.0		35.02	28.28			CTD-16		CTD down to 200m (18O, metals)
													surface (bucket)	water sample + nanno+diatom
		17:30	9:30	22°59.13"	108°09.59"			35.08	26.20				plankton haul	0-40, 40-200
					22°59.13"	108°09.59"			35.08	26.20				plankton tow
18		23:45	15:45	21°59.76"	108°50.43"	4776.5		35.13	25.96			CTD-17		CTD down to 200m (18O, metals)
				21°59.76"	108°50.43"			35.13	25.96				surface (bucket)	water sample + nanno+diatom
				21°59.76"	108°50.43"			35.13	25.96				plankton haul	0-40, 40-200
		27.2.96	0:17	0:27	21°59.76"	108°50.43"			35.13	25.96				plankton tow
19		6:52	22:52	20°59.68"	109°29.68"	5050.0		35.25	25.78			CTD-18		CTD (5024m) (18O, metals)
													surface (bucket)	water sample + nanno+diatom
		10:12	2:12	20°59.25"	109°30.54"			35.20	25.82				plankton haul	0-40, 40-200
													plankton tow	10 min

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February 21 1996 - March 6 1996

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Station List

Station	date (local)	time (local)	time (UTC)	lat. (°S)	long. (°E)	water depth (m, sound)	water depth (m, cable)	SSS (‰)	SST (°C)	corer	recovery (cm)	CTD	plankton/ water sample	remarks
20		10:53	2:53	20°59.74'	109°31.24'			35.20	25.87			CTD-19		CTD down to 200m (18O, metals)
		17:30	9:30	19°59.98'	110°09.95'	4335.0		34.98	27.99			CTD-20		CTD down to 200m (18O, metals)
				19°59.98'	110°09.95'			34.98	27.99				surface (bucket)	water sample + nanno+diatom
		17:42	9:42	19°59.98'	110°09.95'			34.98	27.99				plankton haul	0-40, 40-200
21		18:00	10:00	19°59.98'	110°09.95'			34.98	27.99				plankton tow	10 min
		21:47	13:47	19°24.64'	110°30.40'	4089.5	4199.0	35.01	28.13	GC-14	82.0			none
		21:50	13:50	19°24.64'	110°30.40'			35.01	28.13				surface (bucket)	water sample + nanno+diatom
		23:38	15:38	19°23.14'	110°31.02'			35.03	28.02			CTD-21		CTD down to 400m (18O, metals, [200m])
	28.2.96	0:25	16:25	19°22.11'	110°31.63'			35.05	28.00				plankton haul	0-40, 40-200
													plankton tow	10 min
22		8:00	0:00	18°00.05'	110°29.87'	4973.0		34.75	28.55			CTD-22		CTD (1166m) (18O, metals)
													surface (bucket)	water sample + nanno+diatom
		8:50	0:50	17°59.56'	110°29.15'			34.75	28.56				plankton haul	0-40, 40-200
		9:15	1:15	17°59.56'	110°29.15'			34.75	28.56				plankton tow	10 min
23		14:45	6:45	17°00.11'	110°29.94'	5614.0		34.86	28.85			CTD-23		CTD down to 200m (18O, metals)
		14:50	6:50	17°00.11'	110°29.94'			34.86	28.85				surface (bucket)	water sample + nanno+diatom
		15:15	7:15	17°00.60'	110°30.51'			34.90	28.83				plankton haul	0-25, 25-200
		15:27	7:27	17°00.60'	110°30.51'			34.90	28.83				plankton tow	10 min
24		21:11	13:11	16°00.05'	110°29.87'	5675.0		34.58	28.93			CTD-24		CTD down to 200m (18O, metals)
													surface (bucket)	water sample + nanno+diatom
													plankton haul	0-40, 40-200
													plankton tow	10 min
25	29.2.96	3:45	19:45	15°00.12'	110°29.80'	5593.0		34.15	29.07			CTD-25		CTD down to 1200m (18O, metals)
		3:45	19:45	15°00.12'	110°29.80'								surface (bucket)	water sample + nanno+diatom
		5:00	21:00										plankton haul	0-40, 40-200
		5:20	21:20										plankton tow	10 min
26		11:22	3:22	15°00.12'	110°29.80'	5215.0		34.04	29.18			CTD-26		CTD down to 200m (18O, metals)
27		17:44	9:44	13°00.00'	110°29.19'	4838.0		34.20	29.55			CTD-27		CTD down to 300m (18O, metals)
		17:50	9:50	13°00.00'	110°29.19'			34.20	29.55				surface (bucket)	water sample + nanno+diatom
		18:00	10:00	13°00.44'	110°29.49'	4921.0		34.24	29.37				plankton haul	0-50, 50-200
		18:22	10:22	13°00.44'	110°29.49'	4921.0		34.24	29.37				plankton tow	10 min
28		23:30	15:30	12°14.41'	110°25.70'	3446.0	3518.0	33.69	29.09	GC-15	409.0			hooray! (7cm core catcher not included)
		23:30	15:30	12°14.41'	110°25.70'			33.69	29.09				surface (bucket)	water sample + nanno+diatom
	1.3.96	0:23	16:23	12°14.04'	110°26.24'			33.71	29.12			CTD-28		CTD down to 300m (18O, metals)
		0:40	16:40	12°14.04'	110°26.24'			33.71	29.12				plankton haul	0-40, 40-200
29		1:00	1:10	12°14.04'	110°26.24'			33.71	29.12				plankton tow	10 min
		7:38	23:38	12°11.29'	111°30.45'	2714.0	2780.0	34.55	28.95	GC-16	377.0			none
								33.66	29.17			CTD-29		CTD down to 300m (18O, metals)
													surface (bucket)	water sample + nanno+diatom
												plankton haul	0-50, 50-200	
												plankton tow	10 min	
30		13:05	5:05	12°12.82'	112°11.98'	4483.0		34.32	29.18			CTD-30		CTD (4500m) (18O, metals)

The Australian Marine Quaternary Program

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RV FRANKLIN -Cruise 2/96, Perth to Dampier

February 21 1996 - March 6 1996

5/3/96

Station List

Station	date (local)	time (local)	time (UTC)	lat. (°S)	long. (°E)	water depth (m, sound)	water depth (m, cable)	SSS (‰)	SST (°C)	corer	recovery (cm)	CTD	plankton/ water sample	remarks
31		19:10	11:10	12°14.80'	112°44.27'	2571.0	2535.0	34.59	29.08	GC-17	475.0			none
		19:20	11:20										surface (bucket)	water sample + nanno+diatom
		20:30	12:30	12°14.69'	112°44.51'			34.56	28.96			CTD-31		CTD down to 315m (18O, metals)
		20:50	13:50										plankton haul	0-50, 50-200
		21:00	14:00										plankton tow	10 min
32	2.3.96	8:15	0:15	12°05.17'	114°27.24'	3189.0	3369.0	34.16	28.93	GC-18	175.0			material lost
													surface (bucket)	water sample + nanno+diatom
		9:09	1:09	12°04.90'	114°27.39'			34.17	28.93			CTD-32		CTD down to 200m (18O, metals)
		9:30	1:30	12°04.80'	114°27.49'			34.17	28.93				plankton haul	0-40, 40-200
33		9:50	1:50					34.17	28.93				plankton tow	10 min
		12:20	4:20	12°22.76'	114°16.96'	3355.0	3467.0	34.23	29.17	GC-19	474.0			none
34		18:02	10:02	13°00.44'	114°04.10'	5356.0		34.38	29.53			CTD-33		CTD down to 500m (18O, metals)
		18:10	10:10	13°00.44'	114°04.10'			34.38	29.53				surface (bucket)	water sample + nanno+diatom
		18:28	10:28	13°00.15'	114°04.33'			34.34	29.31				plankton haul	0-50, 50-200
		18:50	10:50	13°00.24'	114°04.56'			34.38	29.28				plankton tow	10 min
35	3.3.96	4:52	20:52	14°35.94'	113°30.17'	2571.0	2629.0	34.52	29.50	GC	0.0			core empty, soft foram sand
		6:13	22:13	14°34.95'	113°30.49'	2497.0	2551.0	34.42	29.28	GC-20	5.0			1 core catcher bag sample only, very sandy
		6:15	22:15	14°35.94'	113°30.17'			34.42	29.28				surface (bucket)	water sample + nanno+diatom
		7:20	23:20	14°34.63'	113°30.69'			34.37	29.28				plankton tow	10 min
36		12:08	4:08	14°48.68'	114°16.37'	2919.0	2975.0	34.15	29.19	GC-21	477.0			none
		12:30	4:30	14°48.68'	114°16.37'			34.15	29.19				surface (bucket)	water sample + nanno+diatom
		13:40	5:40	14°48.17'	114°15.88'			34.17	29.92			CTD-34		CTD down to 300m (18O, metals)
				14°48.17'	114°15.88'			34.17	29.92				plankton tow	10 min
37	4.3.96	5:34	21:34	16°34.71'	113°11.98'	2501.0	2524.0	34.38	29.52	GC-22	508.0			none
38		8:36	0:36	16°54.81'	113°20.14'	1987.0	2003.0	34.99	29.53	GC-23	439.0			none
		9:40	1:40	16°54.56'	113°20.33'			35.05	29.47			CTD-35		CTD down to 500m (18O, metals)
		10:00	2:00	16°54.56'	113°20.33'			35.05	29.47				plankton haul	0-50, 50-200
		10:20	2:20	16°54.56'	113°20.33'			35.05	29.47				plankton tow	10 min
39		18:52	10:52	16°55.61'	114°15.46'	1602.5	1632.0	34.90	29.86	GC-24	700.0			7m steel pipe installed!
		19:00	11:00	16°55.61'	114°15.46'			34.90	29.86				surface (bucket)	water sample + nanno+diatom
		19:20	11:20	16°55.27'	114°50.81'			34.89	29.87			CTD-36		CTD down to 500m (18O, metals)
		19:40	11:40	16°55.27'	114°50.81'			34.89	29.87				plankton haul	0-50, 50-200
		10:20	2:20	16°55.27'	114°50.81'			34.89	29.87				plankton tow	10 min
		23:00	15:00	16°54.65'	115°15.90'	1666.0	1686.0	34.42	29.46	GC-25	640.0			7m steel pipe installed!
41	5.3.96	1:28	6:43	16°54'	115°31'	1958.0	1988.0	34.50	29.71	GC-26	638.0			7m steel pipe installed!
42		14:35	6:35	18°33.71'	116°16.01'	1023.5	1038.0	34.85	29.38	GC-27	624.5			7m steel pipe installed!
		14:50	6:50	18°33.54'	116°16.07'			34.87	29.37				surface (bucket)	nanno only
		15:16	7:16	18°32.98'	116°16.41'			34.87	29.36			CTD-37		CTD down to 200m (nutrients & nanno only)
43		17:30	9:30	18°47.93'	116°20.23'	502.0	520.0	34.83	29.50	GC-28	650.0			7m steel pipe installed!
44		19:10	11:10	18°57.81'	116°23.52'	344.0	355.0	34.85	29.17	GC-29	607.5			7m steel pipe installed!

Core stats: 93.1 m