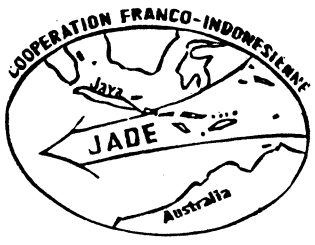
FRENCH-INDONESIAN COOPERATIVE INVESTIGATION
IN PHYSICAL OCEANOGRAPHY

JADE 98 CRUISE

on board the
K/R BARUNA JAYA IV

16 - 25 March 1998
Benoa - Kupang

CRUISE REPORT



On board the K/R Baruna Jaya IV,
the 24th of March 1998
Michèle Fieux

1 - Objectives of the cruise

The objective of the JADE (Java-Australia Dynamic Experiment) programme is the study of the throughflow between the Pacific and the Indian Oceans which represents a fundamental link as well in the study of the general oceanic circulation (WOCE (World Ocean Circulation Experiment) programme) as in the climatic studies which are related to it (CLIVAR (CLImatic VARiability) programme, Global Change). It includes the measurement of the characteristics of the water masses to study their origin and their mixing. It also includes direct current measurements in the narrow and deep passages which link the Banda Sea and the Indian Ocean north and south of Timor Island.

A scientific collaboration between French and Indonesian scientists has included already two cruises on board the R/V Marion Dufresne in 1989 and 1992, four cruises on board the Baruna Jaya I in 1990, 1992, 1993, 1995 and one cruise on board the Baruna Jaya IV

The JADE 98 cruise is the seventh cruise of the Franco-Indonesian JADE programme.

The specific objectives of this cruise were:

- first, to measure directly the currents during one year in both deep passages north and south of Timor, i.e. in Ombai Strait and in Timor Passage, to determine the partition of the throughflow from the Banda Sea toward the Indian Ocean, between the two passages.

- second, to get some informations on the water masses through CTD stations and on the upper layer currents through ADCP measurements along the route and in Ombai Strait.

2 - Summary of the cruise

Just before the cruise, the beacon of the Timor mooring poped up unexpectedly at the surface and transmitted its position through Argos. So the first priority was to search as quickly as possible for the drifting mooring. The mooring was retrieved with the three currentmeters.Then we made two CTD stations down to 3000m in the Indian

Ocean before entering the Savu Sea. Along the route the hull mounted ADCP was on from the 16th afternoon till the end of the cruise. The Ombai mooring had been retrieved but the shock of the trawler which cut the head of the mooring last year distroyed the upper instrument and opened the second instrument. Within the SPGA programme, the two American pressure gauge of Alor and Timor were retrieved and replaced. ADCP transects were repeated across Ombai Strait during 43 hours. 14 CTD stations were carried out across Ombai Strait, between Alor and Kambing, and between Kambing and Timor. The cruise track is presented on Figure 1.

3 - Description of the cruise

We were welcomed by Dr. A. Gani Ilahude and Djoko Hartoyo at the airport of Denpasar. Komandan Handoko welcomed us on board the Baruna Jaya IV when we embarked on the 16th of March. As one of the mooring site is in Ombai Strait and as two shallow pressure gauges are sited in the same passage, the cruise leg includes 2 days for the Shallow Pressure Gauge American-Indonesian programme (SPGA). The participants include four French and two American scientists (see section 5).

We left Benoa on the 16th of March at 8.00 towards the last position of the mooring given by the satellite beacon mounted on the head of the mooring, received by phone from Paris.

The cruise objectives were presented on the morning of the 17th to Komandan Handoko and his crew, and to the scientists from BPPT and LIPI. In the middle of the meeting a signal from the satellite beacon was first heard on the IESM gonio receiver.We search for it and found it 2 hours after the first reception (Figure 2). The three currentmeters were retrieved with the floats but the release was missing (Figure 3). The Aanderaa currentmeter placed near the bottom of the sill worked well during the whole period (9 March 97 - 21 February 98) (Figure 4). The two Mors currentmeters located at 1550m and 1300m presented some gaps in the records (Figure 5). The first look shows that the tidal currents are strong even near the bottom (Figure 6).

After the retrieval of the Timor mooring, two CTD stations were carried out down to 3000m with the GMI CTD conducted by the Indonesian scientists. Then to calibrate the ADCP a section to the north was followed for 30 minutes and then, along Sumba island, bottom tracking was done on shallow depths with a 180° reverse route for a while. Then we steamed towards Flores to make ADCP sections across all the different channels between the Solor

islands and Alor. Due to the lack of small sampling bottles, only two samples were taken on each stations. The water samples were analyzed with the salinometer which gave correct values for the deep water of the Indian Ocean.

We arrived in Ombai Strait on the 19th of March at 12.30. We started directly to search for the mooring. We got very quickly a response and went to a minimum distance of 0.38 miles. Then we decided to approach one of the possible positions. The listening gave us a distance close to the other position. So we went there, but during the transit the release of the mooring (which was 2000m above the bottom) had changed position. We made several two other listening and they were not coherent with the previous ones. So we decided not to trigger it that day because it was too late in the afternoon. We figure out that, as the release was 2000m above the bottom, and as tidal currents are still very strong at that depth, the mooring was rotating and the release was always changing position with the tidal currents.

During the night, 4 CTD were done by the Indonesian team in Ombai Strait down to 3000m with 6 bottles mounted with reversing thermometers. The water sampling was done for nutrients at 12 levels and for salinity at two deep levels to try to calibrate the CTD.

The next morning, we started a little in the SE of the launching position, and we got one crossing in the north, so we went back north and started another listening which gave a distance of 0.37 mile so we triggered it at once. We followed it up to the surface, and as we were drifting faster than the mooring we came back towards it and found all the instruments (Figure 7). The rubber boat was sent to catch the head of the mooring and brought back to the ship.This mooring was caught last year, two days after the launching, by, we think, a trawler which cut the head of the mooring (Figure 3) It was located by satellite with the Argos beacon, and the Baruna Jaya IV with Nan Bray team found it in the south of the Banda Sea where it had been drifting with two currentmeters. When we retrieved the rest of the mooring the upper currentmeter was completely bended, the rotor was destroyed, and the instrument full of water had exploded. The other currentmeter which was at 1250m had also been struck very badly and the lithium batteries had also exploded inside. No data could be recovered from the damaged instruments. At least, the release worked fine and did not suffer any damage.

The American pressure gauge (P1 on the map), on the Alor side of Ombai Strait was found, retrieved and replaced.on the afternoon of the 20th. During the night, ADCP transects were carried out and the bathymetry was taken on the first transect. The next morning, on the 21st, the American pressure gauge (P2 on the map), on the Timor side, was found and retrieved, and replaced in the afternoon.

Then we started repeated ADCP transects across Ombai Strait for 48 hours to be able to eliminate the tidal signal which is very strong here.

The T-S diagrams of the GMI CTD showed a strong offset in salinity but also a problem with pressure (Figure 8). During one ADCP transect, the bathymetry has been recorded; the shape of Ombai Strait is given on Figure 9. On the morning of the 23rd of March at 10.30, during an ADCP transect, an engine problem stopped the ship for 4 hours, and stopped the ADCP time series. Then 10 CTD stations were carried out with the GMI 1000db between Timor and Alor, between Alor and Kambing and between Kambing and Timor (Figure 10). Among them two CTD stations were associated with the American Ocean Sensors CTD (0-500m), and one with five levels of water samples for calibration.

The currentmeter, CTD, salinometer, nutrients, bathymetry,ADCP, and meteorological data have been copied and given to each party. The currentmeters data with the corresponding programs have been given to the Indonesian party in the Matlab format directly usable for analysis.

4 - Conclusion

The objectives of the cruise were not fulfilled as the instruments were destroyed in Ombai Strait and no data could be retrieved there. The Ombai Strait seemed to be a very difficult place to make current measurements. Last year we were very lucky to find the whole mooring with one year of data in the hands of Buton fishermen.

In Timor Passage, we had more chance as we managed to catch the drifting mooring with nearly one year of data.

The GMI CTD is not adequate to make scientific measurements. It is impossible to run the CTD automaticaly when samples are taken, which is necessary to calibrate the data. Some more specific spare parts regarding the new equipment will greatly help for future experiment; for example small glass bottles are necessary to make salinity measurements. The Guildline autosal salinometer is working very well but without small bottles to take the water samples it cannot be used efficiently.It is necessary to have a CTD on board in working conditions. An accurate scientific CTD has to be envisaged in the near future to equip the Baruna Jaya IV, together with reshaping and calibration of the BJI Guildline in a specific center.

5 - Cruise participants

JADE 98 French participants

Michèle Fieux	LODYC-CNRS	Co-Chief Scientist
Robert Molcard	LODYC-CNRS	Scientist
Jacky Lanoisellé	LODYC-CNRS	Engineer
Catherine Rouault	LODYC-CNRS	Engineer

JADE 98 Indonesian participants

Dr. A.Gani Ilahude	P3O-LIPI	Co-Chief Scientist
Ir.Wahyu Widodo Pandoe	BPPT	Scientist
Ir. Djoko Hartoyo	BPPT	Scientist
Ir. Muhamed Ilyas	BPPT	Scientist
Ir. Ali Alkatini	BPPT	Scientist
Ir. M. Hasanuddin, MSc	P3O-LIPI	Scientist
Mardanis	P3O-LIPI	Technician
Mustofa	BPPT	Technician
Suyatmin	BPPT	Technician
Tatang Supardi	BPPT	Technician
Muhamad. Jackfar	BPPT	Technician
Rudi	BPPT	Steward
Fritz	BPPT	Steward
Agus	IPB	Student
Sulchan	IPB	Student

American participants for the SPGA programme during the JADE 98 cruise

Janet Sprintall	SCRIPPS	Scientist
Thomas Moore	CSIRO	Scientist

6 - Aknowledgments

We would like to transmit warm thanks to Komandan Handoko and all his crew for their warm welcome on board; we greatly appreciate the excellent professional and amicable support of our work at sea and their kindness with which they adapted to the changes in the programme due to the problems we encountered. Despite the design of the ship which is more dedicated to fisheries work, the moorings were retrieve very carefully by the crew.

We appreciate very much the excellent and warm cooperation with Dr. Abdul Gani Ilahude, Wahyu Pandoe, Djoko Hartoyo and the BPPT and LIPI team; they have been always very helpful. They had to face many problems in regard to the functioning of the CTD and the hull-mounted ADCP. They have done the best that they could in such conditions.

We would like to add that the food was excellent, we appreciate the nice lodging which was very helpful for meeting each other during the work, and the kind thought of giving us bread, butter and jam for breakfast.

The support of INSU for the cruise is greatly aknowledged.

Prof. M.T. Zen, Dr. Indroyono and his team at BPPT led by Basri Ganie, seconded by Bambang Herunadi have been supporting this Franco-Indonesian cooperative programme since the beginning and have put a lot of continuous efforts in the fulfilment of the scientific cooperation, we wish to thank them warmly.

Appendix 1

CTD stations list

N° St	Latitude (lintang) South (Selatan)	Longitude (bujur) East (Timur)	Depth (m)(kedalaman air	Day 1998 (tinggal)	Time GMT+8 (jam)	Max ctd(db) (kedalaman ctd)	Wind (m/s), direction (angin, arah)
1	11°15'59	119°34'53E	5946	16 March	15.52	3000	1.3, ESE
2	11°03'82	119°45'24	3862	17 March	19.10	3000	2.6, ESE
3	8°24'11	125°03'60	1200	19 March	16.47	900	5.7, ENE
4	8°28'00	125°04'37	3214	19 March	18.12	3000	4.9, ENE
5	8°32'12	125°04'97	3000	19 March	22.02	3000	5.9, ENE
6	8°35'95	125°05'43	2118	20 March	02.50	1500	2.8, SSW
7	8°35'10	125°05'66	2484	23 March	15.59	500	3.7, E
8	8°31'24	125°05'00	3232	23 March	17.20	500	4.2, E
9	8°28'00	125°05'00	3221	23 March	18.48	500	4.9, E
10	8°24'52	125°04'45	1778	23 March	20.07	1000	1.0, E
11	8°18'71	125°11'06	760	23 March	22.55	500	1.0, SE
12	8°17'92	125°19'16	1212	24 March	01.00	1000	7.4, N
13	8°16'90	125°26'99	822	24 March	03.24	500	5.8, NW
14	8°19'18	125°30'41	1085	24 March	05.08	500	10.3, N
15	8°24'52	125°30'24	1885	24 March	06.25	1000	4.5, N
16	8°19'10	125°27'00	898	24 March	07.49	500	3.2, N

List of Figures

Figure 6. Six days of the Aanderaa record showing the tidal period of the currents on the two components(speeds are in cm/s)

Figure 7. Search for the Ombai mooring with the two drifts and the recovery position.

Figure 8. T-S diagrams of stations 3, 4, 5, 6 in Ombai Strait, showing the problem with pressure below 1500m (the temperature does not change and the salinity is decreasing too much for those levels).

Figure 9. Bathymetry across Ombai Strait between P2 and P1, during an ADCP transect.

Figure 10. Location of the CTD stations between Timor, Alor and Kambing.

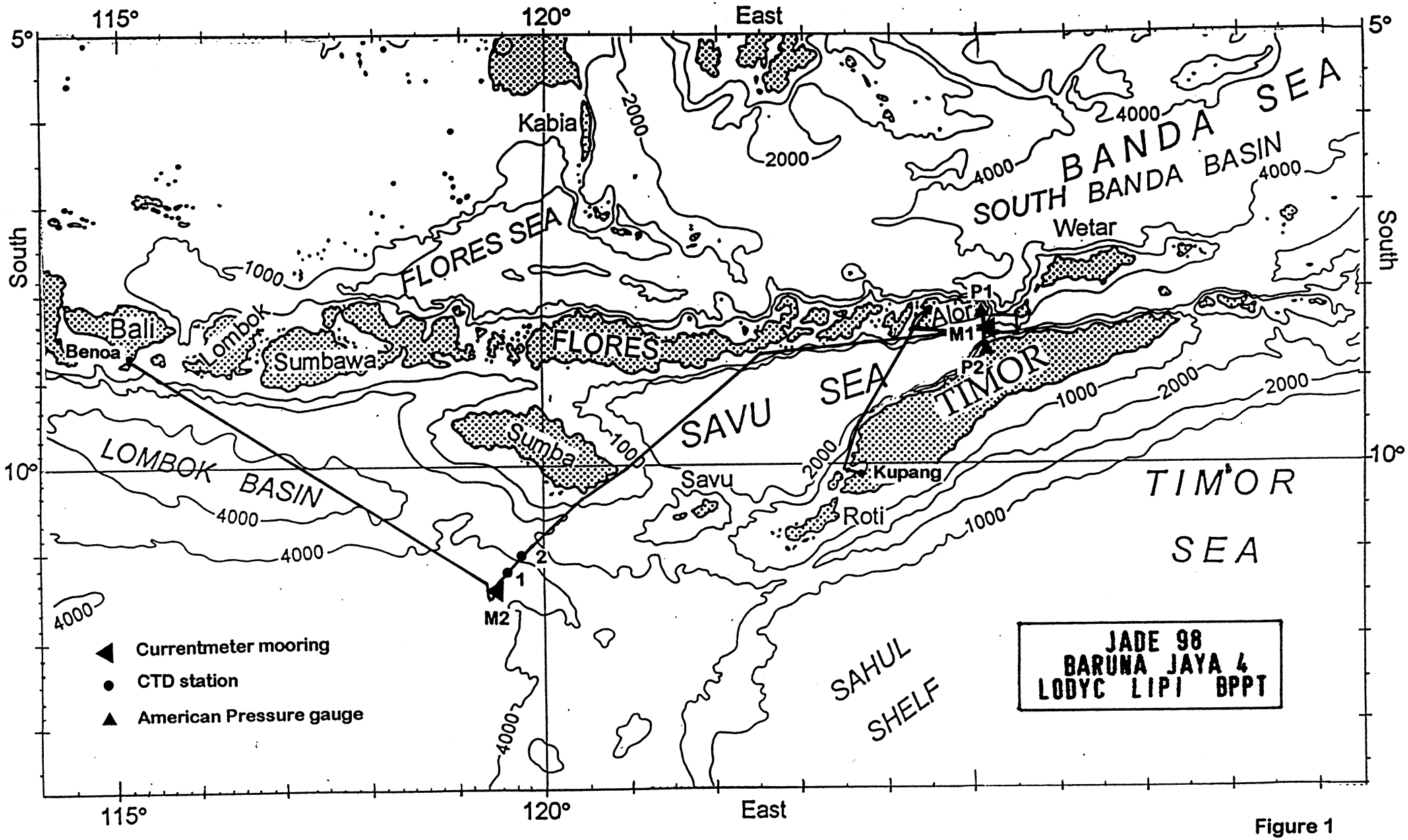

115°
120°
East
5°
10°
South
Kabia
2000
4000
BANDA SEA
SOUTH BANDA BASIN
Wetar
FLORES SEA
1000
Bali
Lombok
Sumbawa
Benoa
FLORES
P1
Alor
M1
P2
TIMOR
SAVU SEA
Sumba
Savu
Kupang
Roti
LOMBOK BASIN
TIMOR SEA
SAHUL SHELF
M2
1
2
Currentmeter mooring
CTD station
American Pressure gauge
JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT

Figure 1

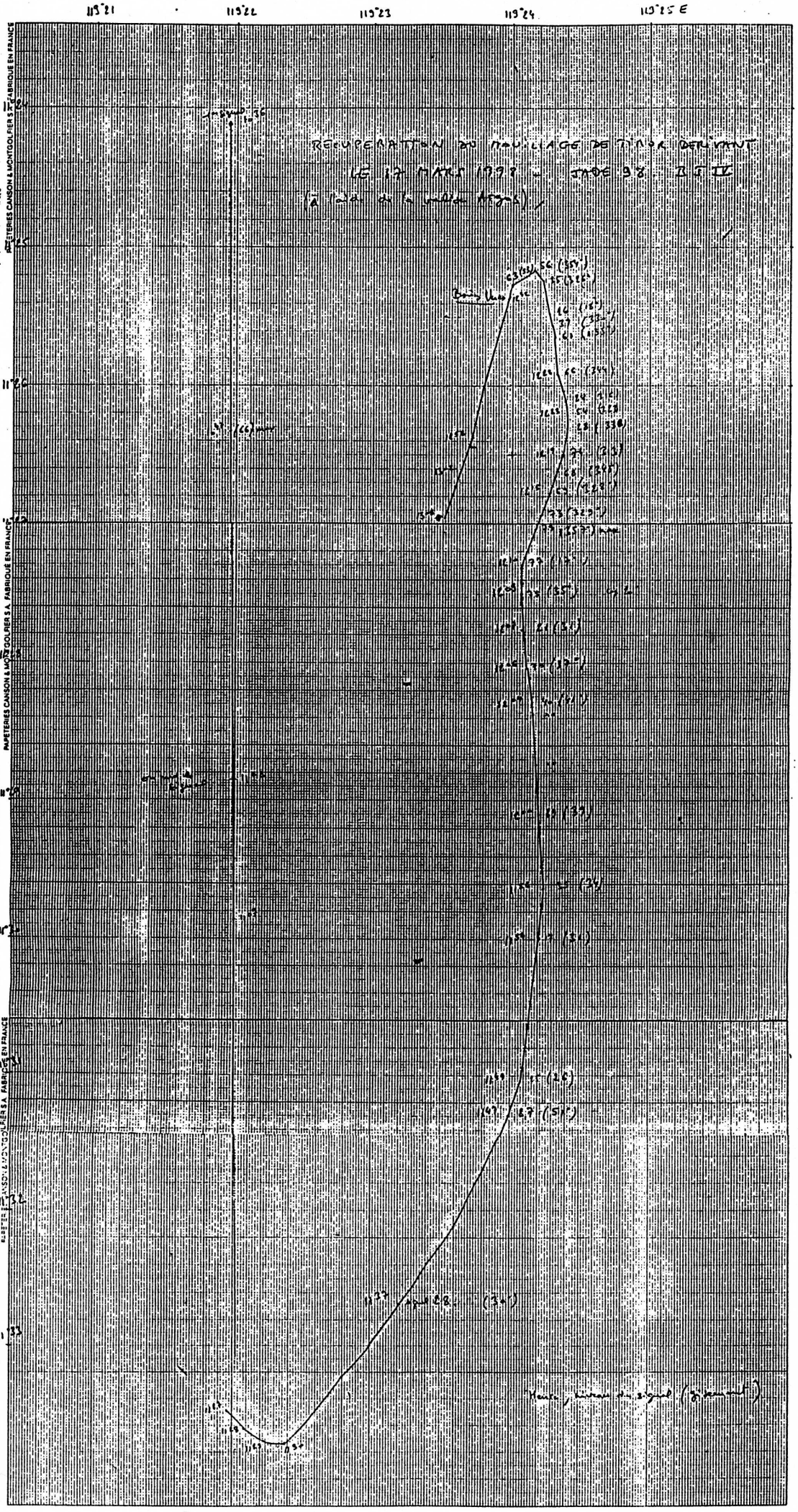

119°21
119°22
119°23
119°24
119°25 E
PAPETERIES CANSON & MONTGOLFIER S.A. FABRIQUE EN FRANCE
RECUPERATION DU NAVILLAGE DE TARA DERIVANT
LE 17 MARS 1998 — JADE 98 II & IV
(à l'est de la zone Argo)

Figure 2

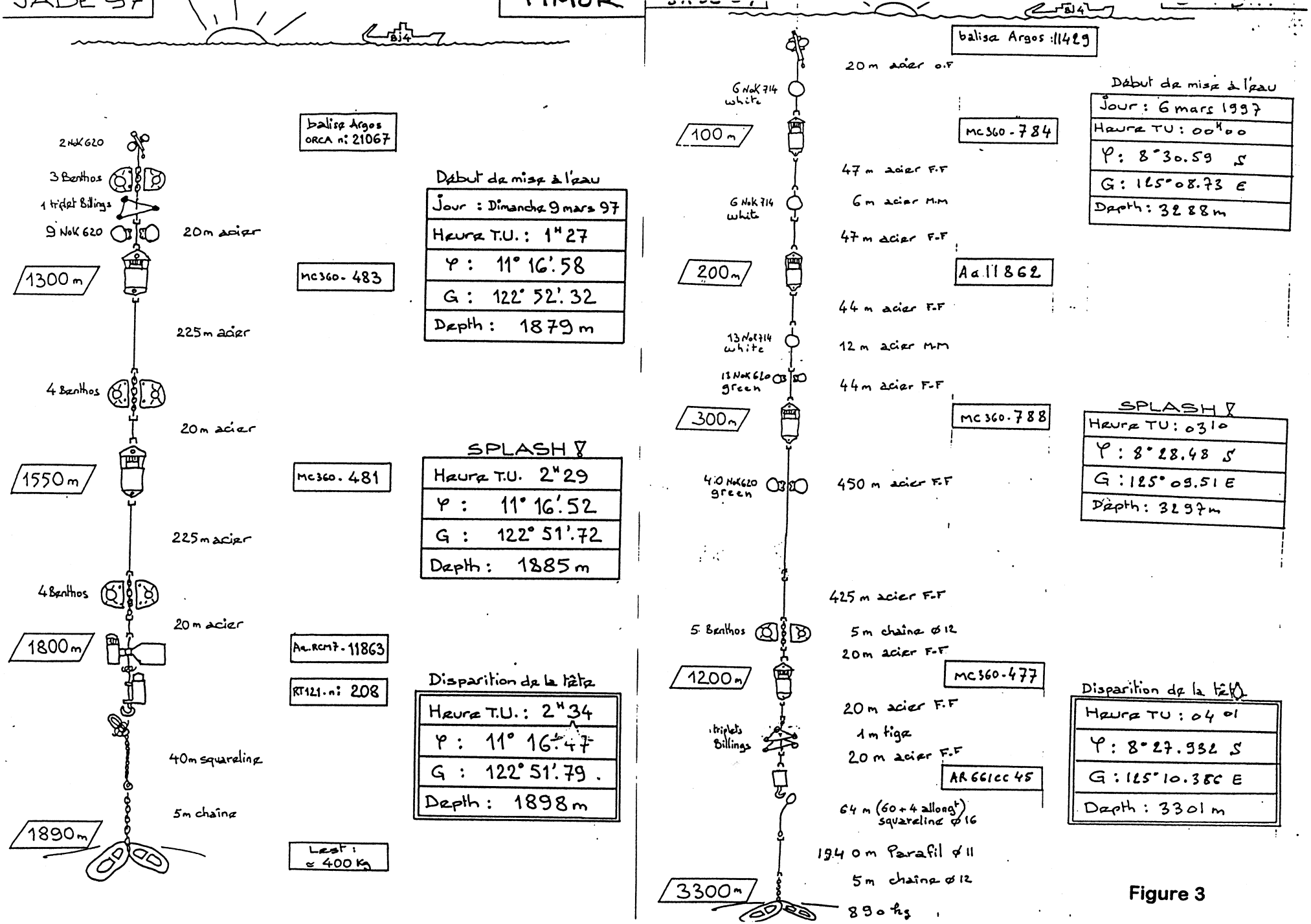
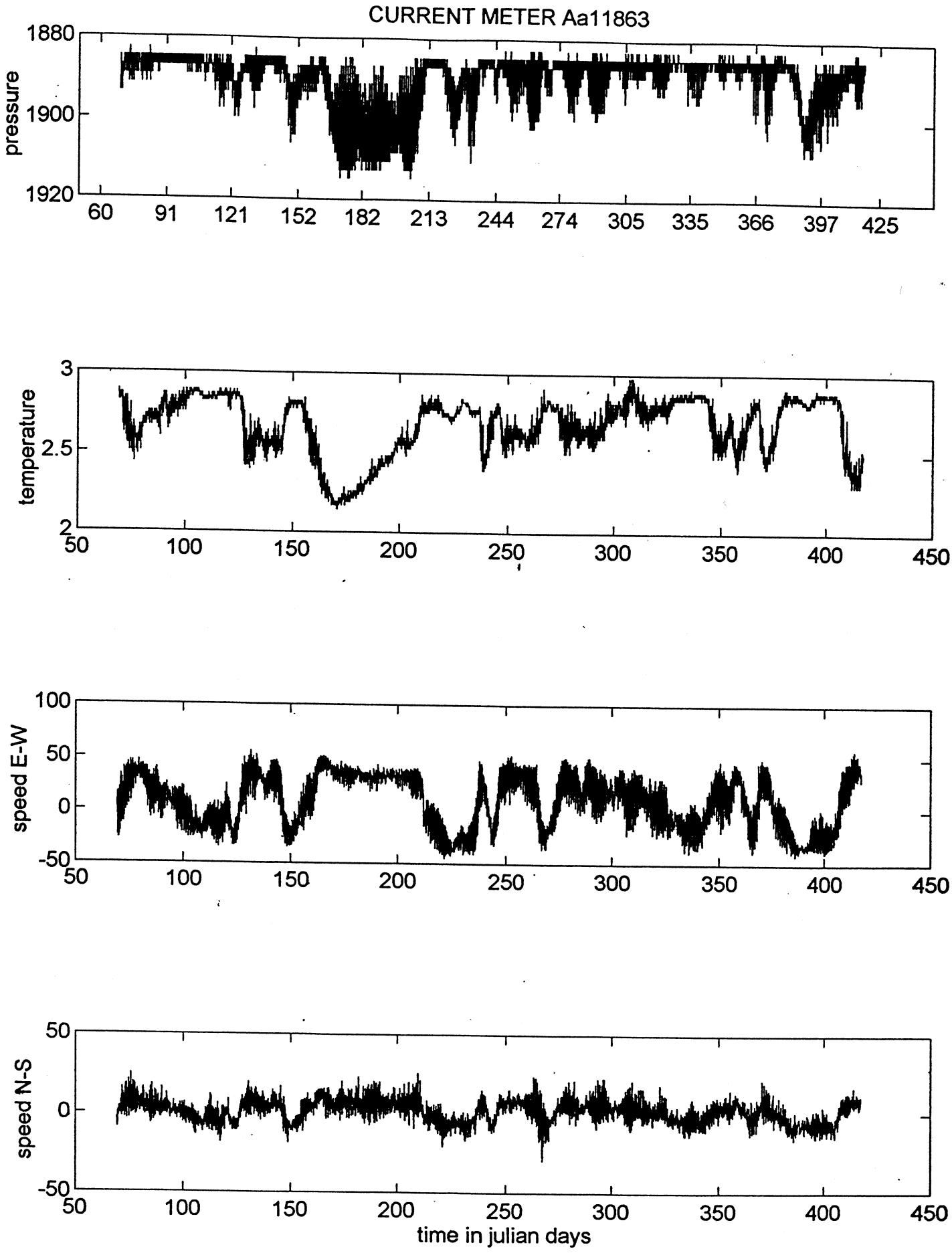
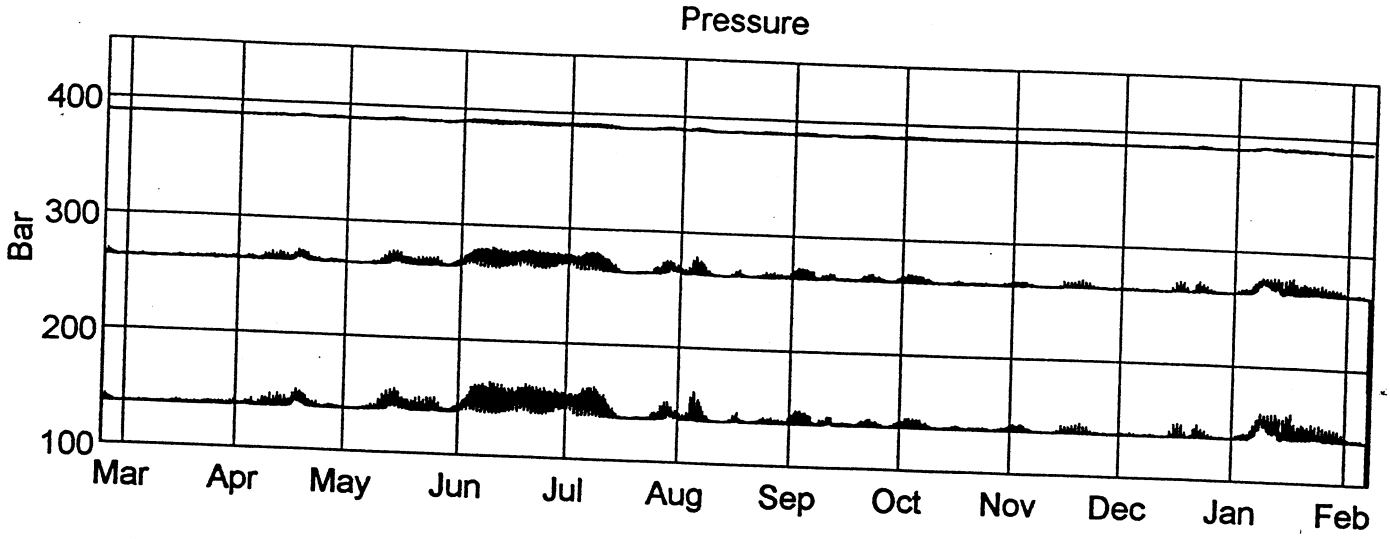

balise Argos ORCA n: 21067
2 NoK 620
3 Benthos
1 triplet Billings
9 NoK 620
20m acier
1300 m
mc360-483
225m acier
4 Benthos
20m acier
1550 m
mc360-481
225m acier
4 Benthos
20m acier
1800 m
Ae.RCM7-11863
RT121.n: 208
40m squareline
5m chaine
1890 m
Lest: ≈ 400 kg
Début de mise à l'eau
Jour : Dimanche 9 mars 97
Heure T.U. : 1H27
Y : 11° 16'.58
G : 122° 52'.32
Depth : 1879 m
SPLASH
Heure T.U. 2H29
Y : 11° 16'.52
G : 122° 51'.72
Depth : 1885 m
Disparition de la tête
Heure T.U. : 2H34
Y : 11° 16'.47
G : 122° 51'.79
Depth : 1898 m
balise Argos :11429
20m acier o.F
6 NoK 714 white
100 m
mc360-784
47 m acier F.F
6 NoK 714 white
6 m acier M.M
47 m acier F.F
200 m
Aa 11862
44 m acier F.F
13 NoK 714 white
12 m acier M.M
13 NoK 620 green
44 m acier F.F
300 m
mc360-788
4.0 NoK 620 green
450 m acier F.F
425 m acier F.F
5 Benthos
5 m chaine ø12
20m acier F.F
1200 m
mc360-477
triplets Billings
20 m acier F.F
1 m tige
20 m acier F.F
AR 661cc 45
64 m (60+4 allongt) squareline ø16
1940 m Parafil ø11
5 m chaine ø12
3300 m
890 kg
Début de mise à l'eau
Jour : 6 mars 1997
Heure TU : 00H00
Y : 8°30.59 S
G : 125°08.73 E
Depth : 3288 m
SPLASH
Heure TU : 0310
Y : 8°28.48 S
G : 125°09.51 E
Depth : 3297 m
Disparition de la tête
Heure TU : 04 01
Y : 8°27.932 S
G : 125°10.386 E
Depth : 3301 m

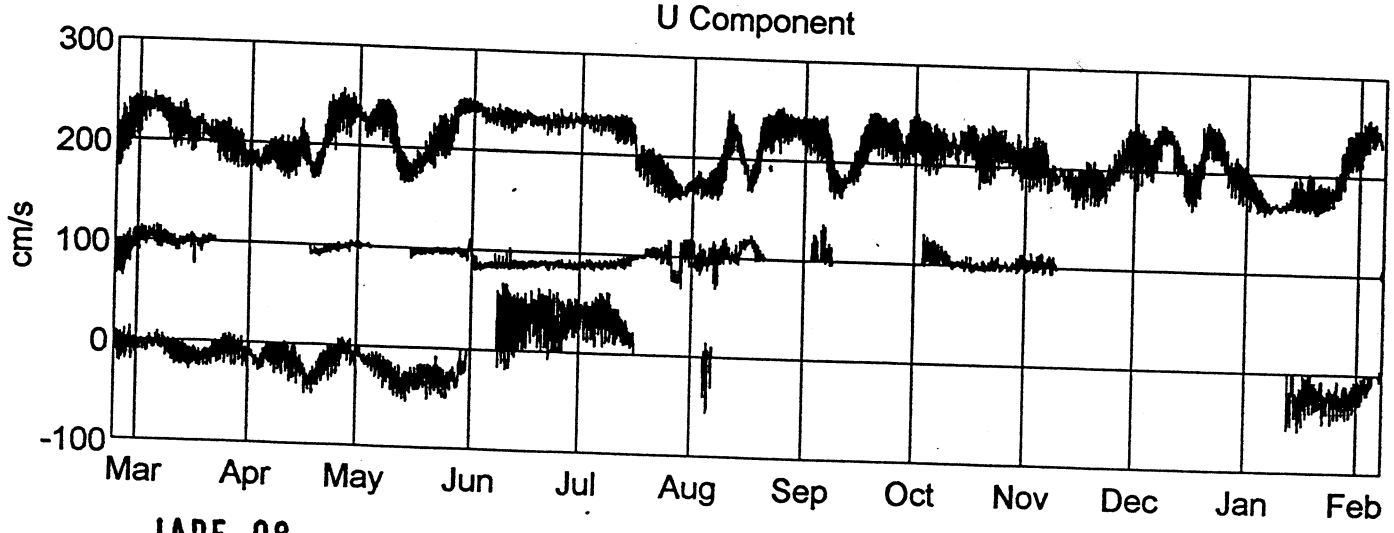
Figure 3



JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT

Figure 4





JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT

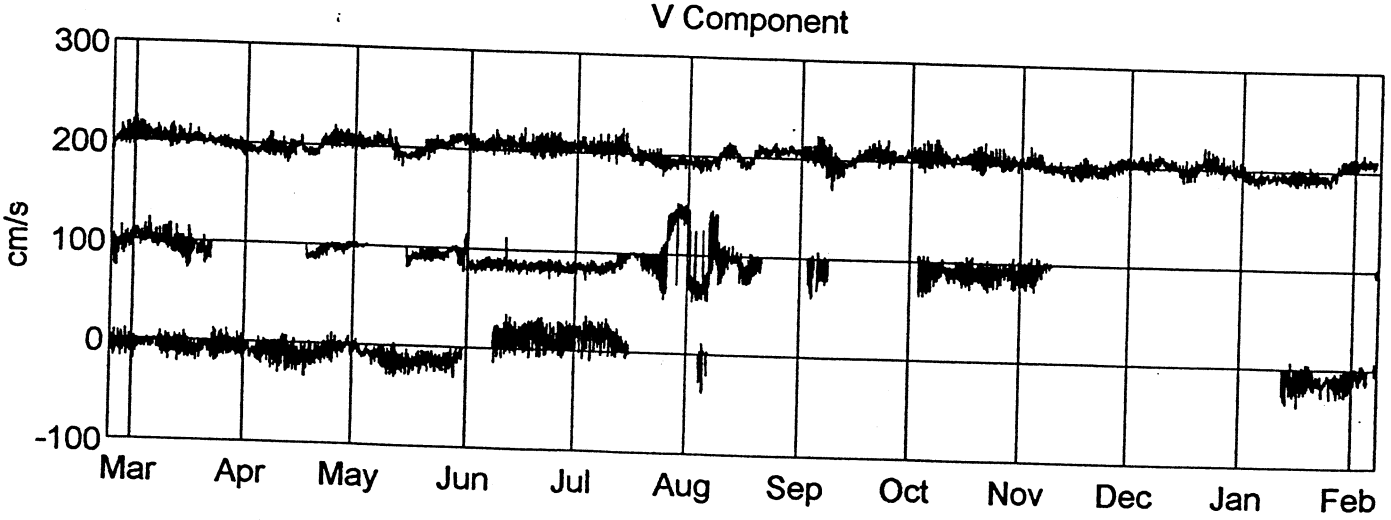


Figure 5

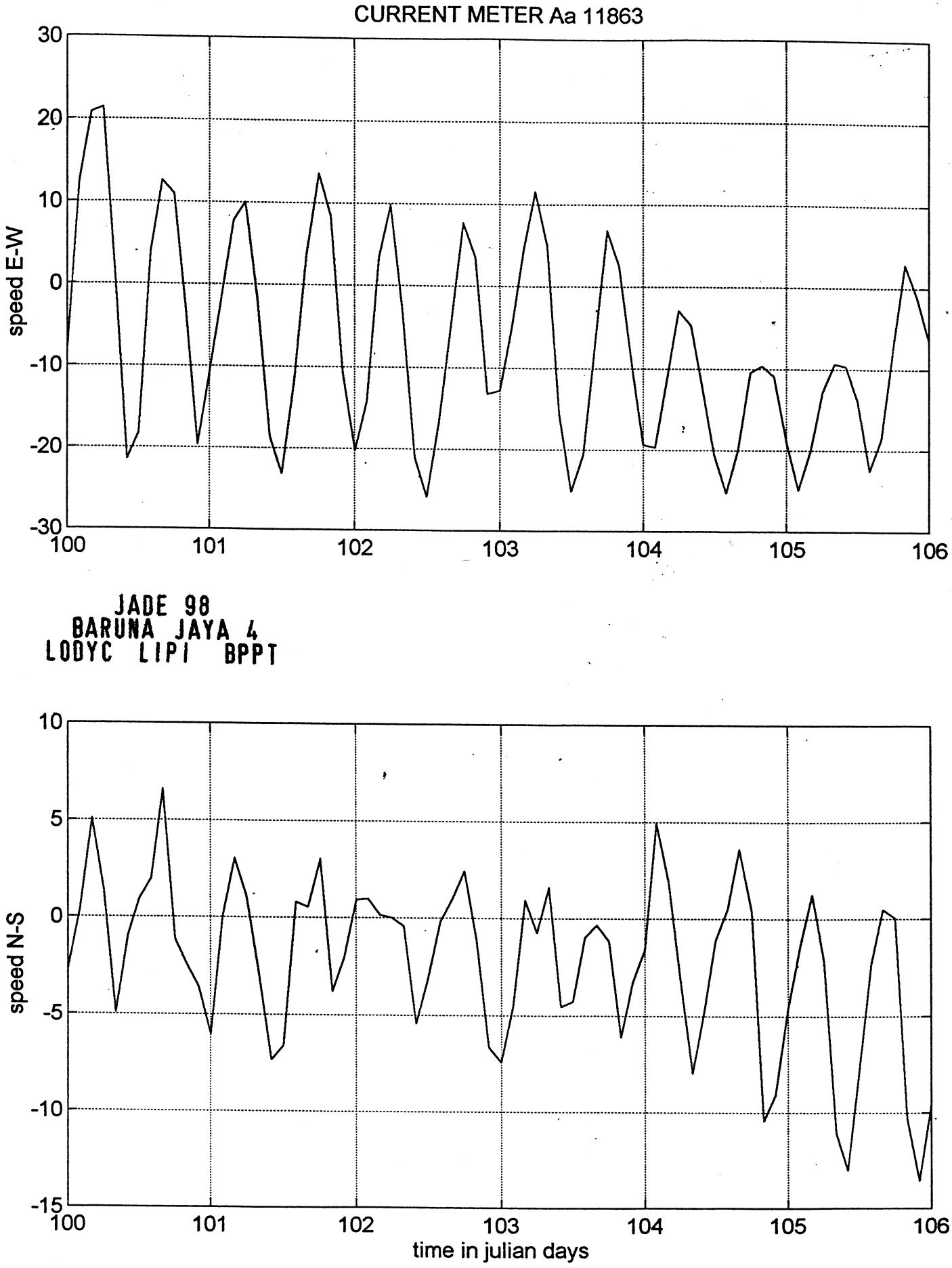

CURRENT METER Aa 11863
speed E-W
30
20
10
0
-10
-20
-30
100
101
102
103
104
105
106
JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT
speed N-S
10
5
0
-5
-10
-15
100
101
102
103
104
105
106
time in julian days

Figure 6

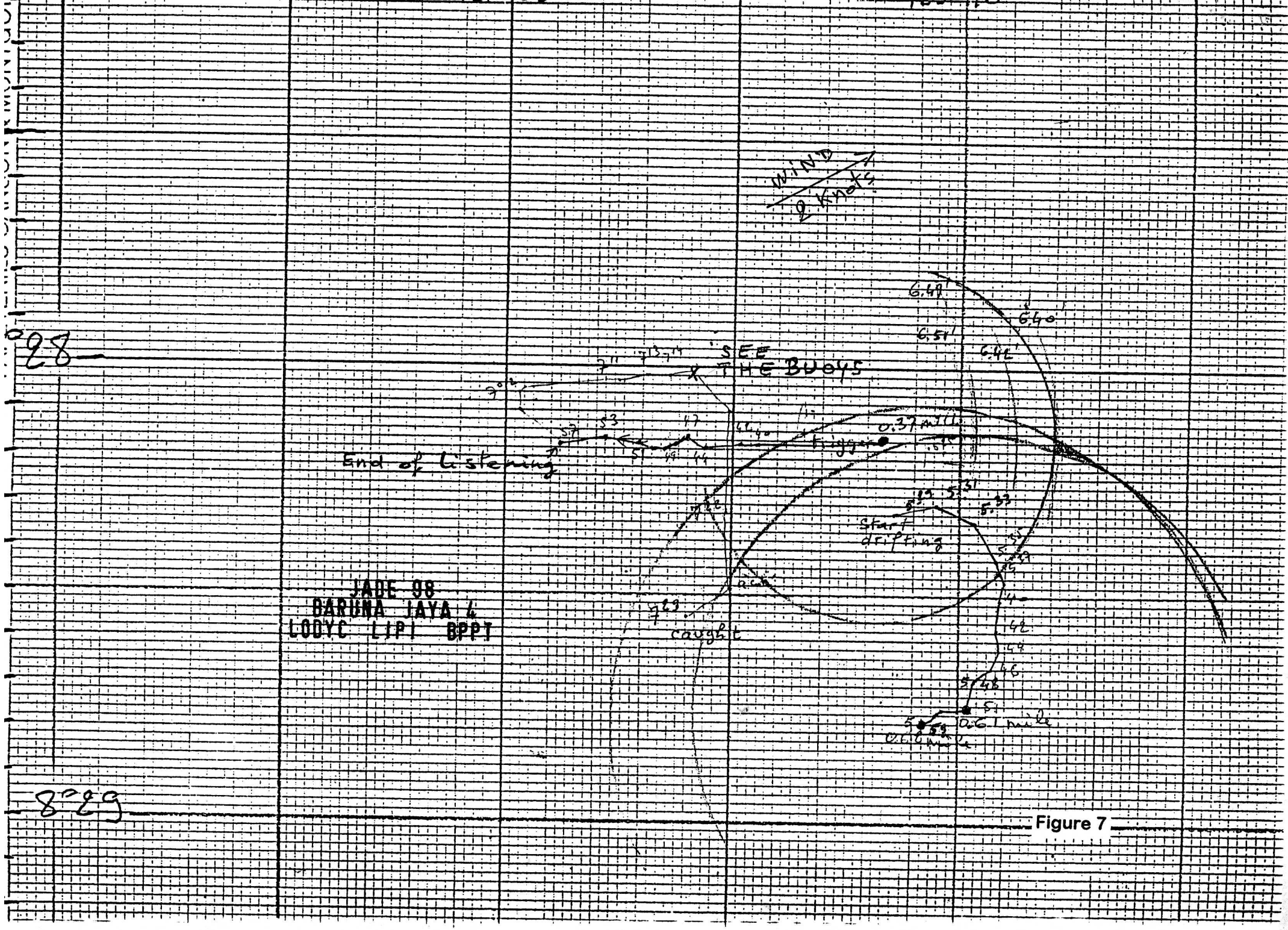

WIND
9 Knots
6.49
6.40
6.51
6.42
SEE THE BUOYS
0.37 mile
End of Listening
Start drifting
caught
0.61 mile
JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT

Figure 7

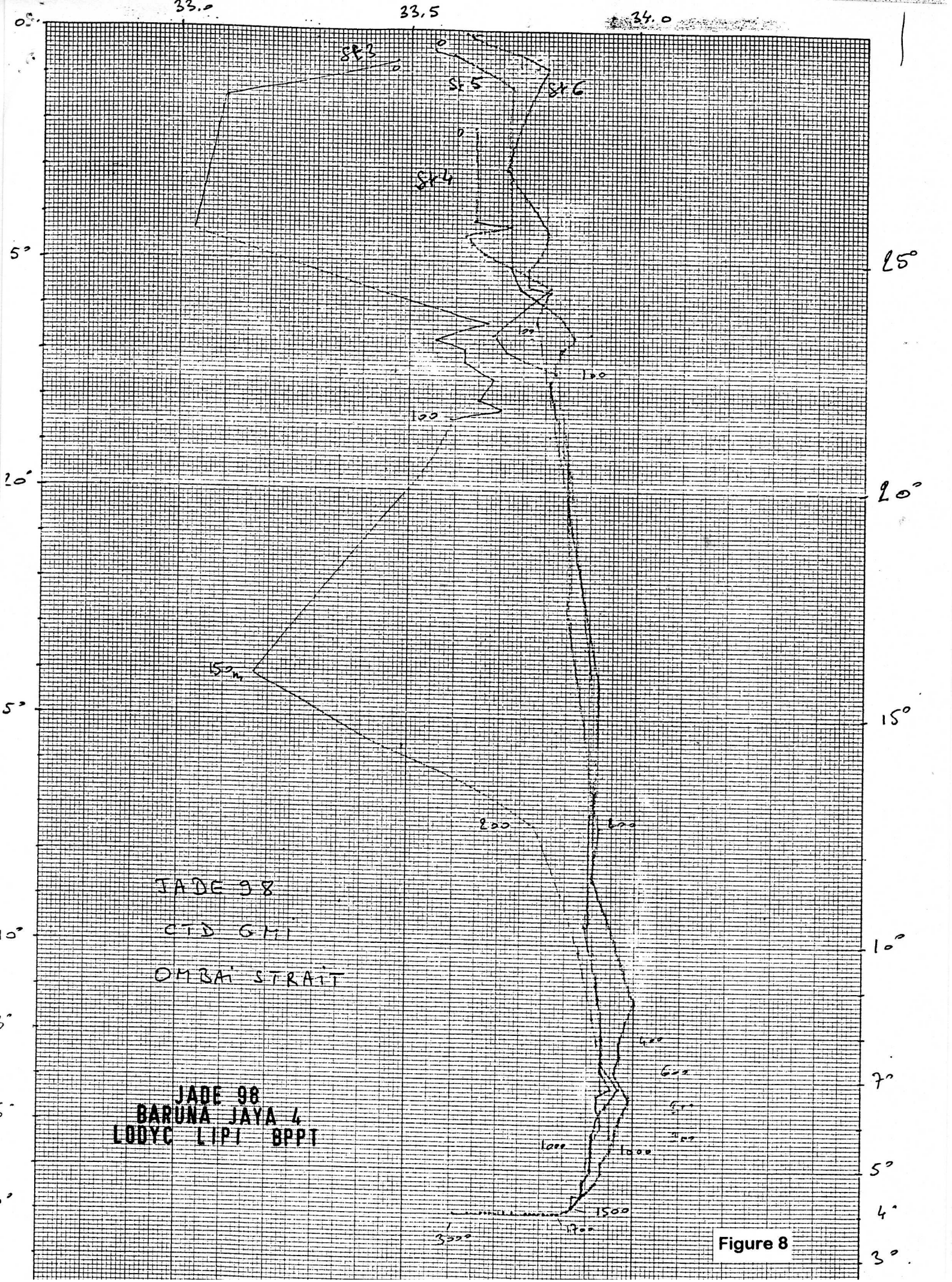

33.0
33,5
34.0
St 3
St 5
St 6
St 4
JADE 98
CTD GMT
OMBAI STRAIT
JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT

Figure 8

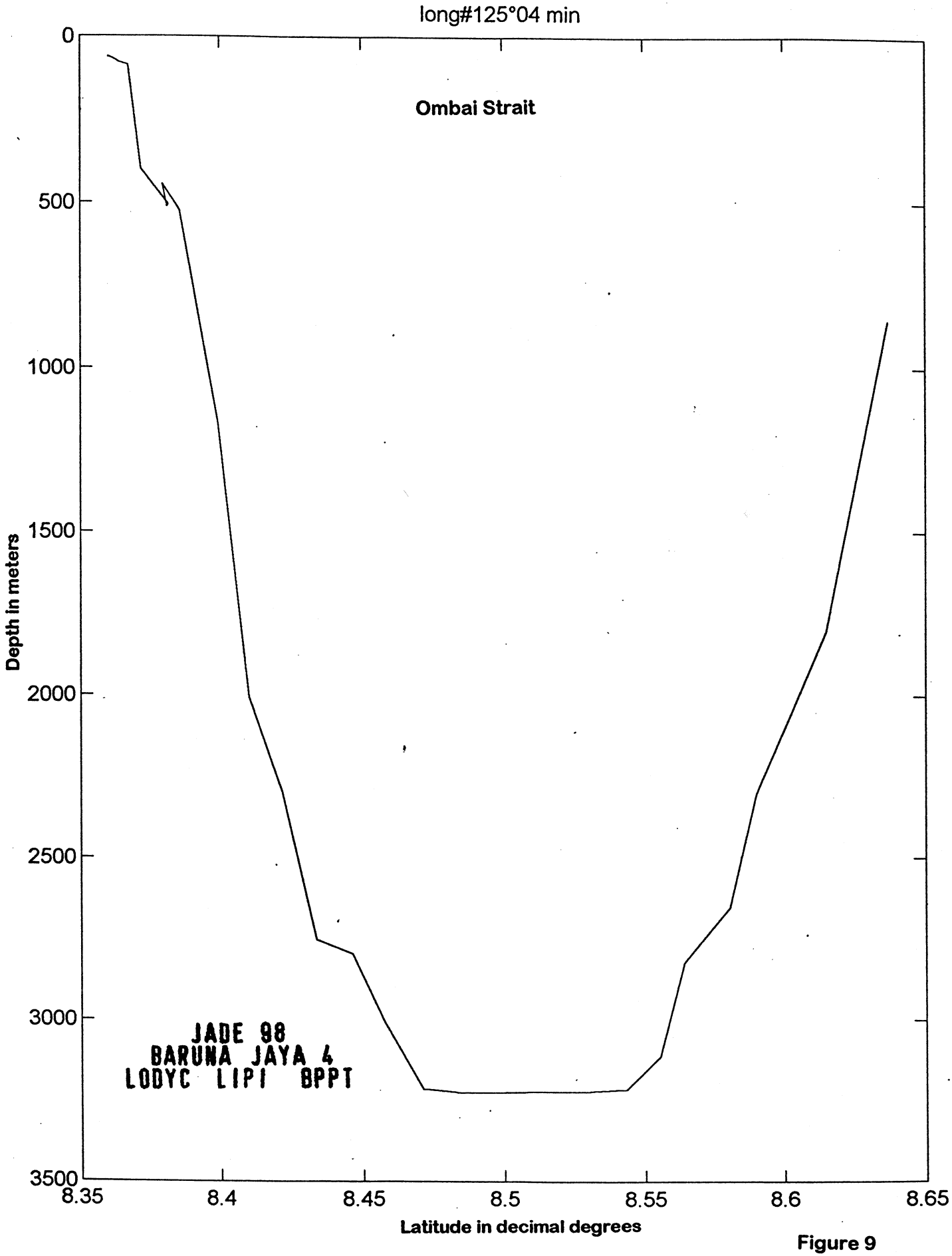

long#125°04 min
Ombai Strait
Depth in meters
0
500
1000
1500
2000
2500
3000
3500
8.35
8.4
8.45
8.5
8.55
8.6
8.65
Latitude in decimal degrees
JADE 98
BARUNA JAYA 4
LODYC LIPI BPPT

Figure 9

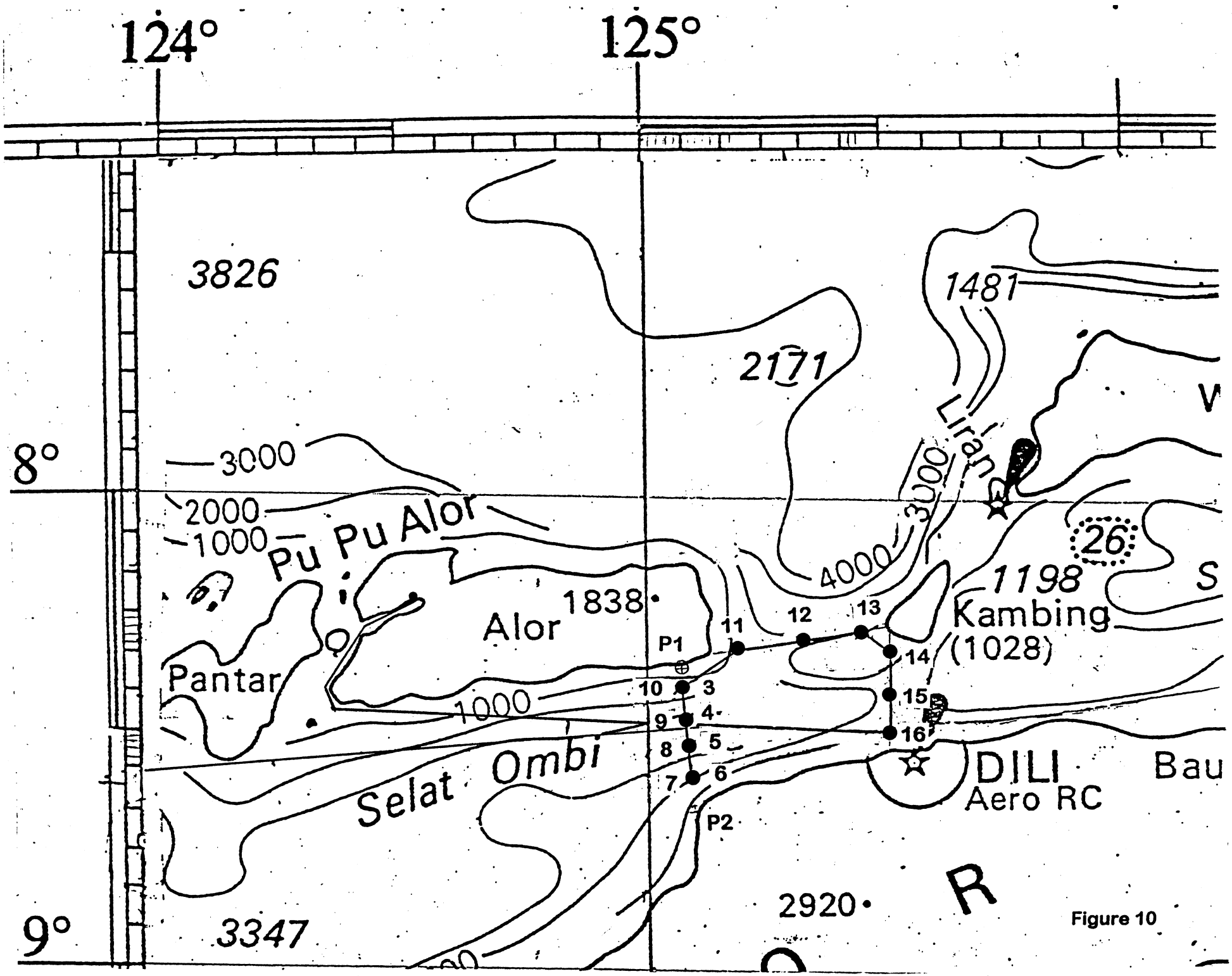

124°
125°
8°
9°
3826
2171
1481
3000
2000
1000
4000
3000
Lirai
Pu Pu Alor
Alor
1838
Pantar
1000
Selat Ombi
1198
Kambing
(1028)
26
P1
P2
10
3
9
4
8
5
7
6
11
12
13
14
15
16
DILI
Aero RC
Bau
2920
3347
R
S
V

Figure 10